Municipal Engineering; Paper No. 2.*

PROVIDENCE, RHODE ISLAND.

The City of Providence is one of the capitals of the State of Rhode Island, and one of the greatest manufacturing centers of the country, as well as the second city in the New England States in population, wealth and importance. The city was first settled by Roger Williams in 1636, and the city charter dates from 1832.

Providence is situated in latitude 41° 49′ 37″ north, and longitude 71° 24′ 31″ west from Greenwich, at the head of Narragansett bay. The Woonasquatucket and the Moshassuck rivers empty from the north into a small basin situated near the business portion of the city. This basin has for an outlet the Providence river, which flows southerly into Narragansett bay. The Seekonk river, which forms the easterly boundary of the city, flows into the Narragansett bay near the mouth of the Providence river. The Woonasquatucket and the Moshassuck rivers divide the city into three parts; the East Side, the West Side and a section comprising the greater part of the Tenth Ward and a portion of the First Ward. Most of the streets are irregularly laid out. The city is very uneven, rising more or less abruptly on the East Side to a height of 202 feet above mean high water, while on the West Side the rise is more gradual, the greater portion of it being a plain, its highest elevation not exceeding 85 feet above mean high water. In the section comprising the greater part of the Tenth Ward the rise is also gradual, although hills and valleys are numerous, its highest elevation being 201 feet above mean high water. This section is not thickly built over, much of it comprising farms and woodland, although many of the manufacturing interests, which are located along the banks of the West, Woonasquatucket and Moshassuck rivers, are within its borders. The public buildings of the city and the mercantile houses stand mostly on Westminster and Weybosset and contiguous streets on the West Side, and along both sides of the Providence river. The dwellings of the city are not compact, they are located largely upon the high ground of the West Side and the Tenth Ward, and upon the hillsides and summits of the East Side. Foliage abounds, and there are many beautiful gardens. The total lineal miles of received streets are 152. Included in this number are the following:

Streets curbed, gutters paved and roadway macadamized or graveled	88	lineal miles.
Streets curbed and paved	19	" "
Streets not curbed or paved	45	" "

The area of the city is 15.65 square miles.

The city of Pawtucket is the only town of much commercial importance within a radius of ten miles of Providence, although the majority of other towns within this area contain many manufacturing villages. The surrounding country is not generally compactly built over, and is mostly farms and woodland. It is generally undulating and elevated. There are no large alluvial tracts, and no very high hills. The summits of the hills, which are numerous to the westward from N. W. to S. W., range from a height of 120 to 550 feet above mean high water. There are quite a number of rivers in the vicinity of Providence, but none of them are very large. They generally have a considerable fall, and in many parts a rapid flow, affording excellent motive power to the manufacturing interests located along their banks. There are also quite a number of large ponds and storage reservoirs within a few miles of the city. The Narragansett bay, at the head of which Providence is situated, is about twenty-eight miles long and about twelve miles wide at its broadest part.

Population.—In 1800, the population was 7,614; in 1820, 11,745; in 1830, 16,836; in 1840, 23,172; in 1850, 41,513; in 1860, 50,666; in 1870, 68,904; in 1875, 100,675, and in 1885 it was 118,070.

Houses.—The present number of houses of all kinds is about 16,250. Separate houses and dwellings of two or more tenements predominate. There are only a few "flats" in the city.

Climate.—The temperature ranges from 17° below zero (Fahrenheit) to 99.5° above; the average being 47.73°. The frost has been known to penetrate the ground to a depth of 7 feet in some portions of the city; but cases of this kind are very exceptional and generally the limit is somewhere between 3 and 4 feet below the street surface. The mean annual rainfall is 44.36 inches.

Geology.—The easterly portion of Providence rests on stratified conglomerate rock, principally overlaid with gravel with occasional strata of sand and clay. The remaining portions of the city are generally underlaid with carboniferous rocks with a covering of gravel and sand deposits, mingled at places with clay.

Finances.—The City Auditor's report for the year ending September 30, 1885, gives the total valuation of real and personal property assessed in the city of Providence as $124,202,000, and the tax for 1885 as $1,800,929, at a rate of $14.50 per $1,000.

The funded debt at the same time was	$8,622,188.22
The floating debt	1,047,128.63
A total of	$9,669,316.85

Classified as follows:

War loan	$300,000.00
City Hall and Sewers	2,000,000.00
Water Works	6,000,000.00
Public Improvements	1,369,316.85
	$9,669,316.85

The means for payment of this debt is a sinking fund, consisting entirely of city bonds and notes of $1,438,328.28.

The Legislature of the State passed an Act in 1878, Section 2 of which reads as follows: After the passage of this Act no town or city shall incur any debt in excess of three (3) per centum of the taxable property of such town or city, including the indebtedness of such town or city at the time of the passage of this Act, etc.

Section 3. No town or city shall assess its ratable property in any one year in excess of one per centum of its ratable value except for the purpose of paying the indebtedness of such town or city, or the interest thereon, or for appropriations to any of the sinking fund, or for extraordinary repairs for damages caused by the elements.

Management of Public Works.

Board of Public Works.—This board is composed of three members elected by concurrent vote of the City Council, one member being elected annually. The board has charge of the water works, sewers and highways, and employs such agents and servants as it deems necessary; the compensation of these agents is fixed by mutual agreement, except that all salaries above $1,000 per annum must be ratified by the City Council.

By request of the board the City Engineer acts as its superintendent.

Bridges.—By city ordinance the City Engineer has charge and control of all public bridges under the direction of the advising committee of the board of aldermen.

Public Buildings.—These are in charge of a Superintendent of Public Buildings who is elected annually by the City Council. He acts under the direction of the standing committee of the City Council on city property, and has care and custody of all the school-houses, buildings, fences and grounds belonging to the city and not otherwise provided for. He employs suitable mechanics and superintends all repairs that may be ordered, and also the construction of all buildings erected by the city.

Public Parks.—The public parks are in charge of a committee of City Council, which appoints a Superintendent of Parks, who has charge of their maintenance.

Health Department.—The board of aldermen is *ex officio* a board of health, and it makes such rules and regulations as are not contrary to the law.

A Superintendent of Health is elected annually by the city electors and performs such duties as are prescribed for him by the City Council.

TO BE CONTINUED.

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Taking Down an Iron Mast.

An interesting and very difficult mechanical feat was performed in Akron recently, in the taking down of an iron electric light mast 213 feet in height above ground. The mast was composed of fifty-five sections of boiler-plate, each fifty inches in length, and varying in thickness from one-half inch at the base, to three-eighths inch, five-sixteenths inch, one-fourth inch, and at the top three-sixteenths inch. The diameter at the base was three feet, and at the top eight inches. The entire weight of the plate removed was eight tons. A change in the system of street-lighting led to the abandonment of the mast, and the contract for taking it down and removing it was given to the Buckeye Machine Company, of Cleveland, whose efficient general manager and engineer, Mr. Ludwig Herman, had charge of the work. From the outset—the mast itself being bent out of plumb and in a dangerous condition—the task presented numerous and trying difficulties, but careful calculation, coupled with cool-headedness and superior engineering skill, were adequate to successfully grapple them all. The method of removal, briefly, was this: Around the lower sections of the mast, to a height of twenty feet, a staging was erected. This was composed of uprights 8″ x 8″, caps 10″ x 10″, sills 8″ x 8″, braces 2″ x 10″, and struts 6″ x 6″, all securely bolted together. From this staging, by means of chain-blocks and swivel-rods and peculiarly-shaped hooks which took hold under the lap of the successive sections, the mast was suspended, while the work of cutting the rivets and removing the sections was carried forward. The hooks in question were held in place by an adjustable band three inches in diameter. After cutting away the lower sections, the whole mast was lowered four inches at a time, the hooks shifted to the lap above, and the lower section cut out again. In this way the work proceeded, the mast being held by ten guys, the manipulation of which required the utmost skill and patience. At one time, during an adverse wind, the top of the mast swayed fifteen inches out of line, but close watching and careful management averted all accidents, and the entire task was successfully completed in a remarkably short period of time. For the first three days one section each day was removed; then three, five and twelve, and on the last day, twenty-seven.—*Iron Trade Review.*

THE Billings, Clarksford and Cook City R. R. Co. has been organized in Montana, to build a road from the main line of the Northern Pacific R. R. at Billings, along or near the north bank of the Yellowstone river to Clark's Fork and up that stream to that city. The capital stock is $1,000,000.

The Harlem River Bridge.

The plan of the proposed Harlem Bridge, illustrated in this issue, is a compromise design upon which bids for construction are asked by the Commissioners for April 22, next.

According to this plan and the specifications the bridge is to consist of two arches of steel each 508 feet span in the clear; three piers of 40 feet width each, and two abutments of stone masonry, 277 feet long on the west and 342 feet long on the east side each being pierced by a 60 foot arched opening. The general height of the roadway above mean high water is 150 feet and the width of the bridge is 80 feet, 50 feet of this being roadway.

The abutment piers and the intermediate pier are to be founded on the solid rock. The west pier and center pier present no difficulties in matter of depth, but the soundings for the east pier show a dip in the rock at the south end only of about 60 feet in the width of the pier foundation (50 feet); it is possible, however, that this sounding has penetrated a fissure in the rock, and further explorations are now being made to ascertain the true conditions of the case.

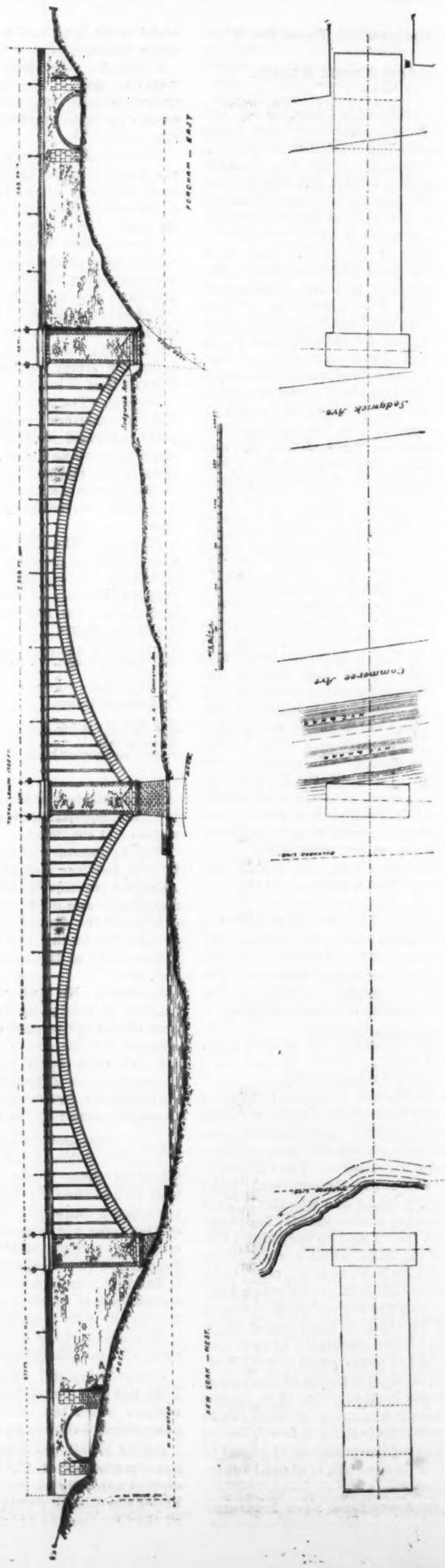
The piers, to one foot below low water, are to be built of a dressed granite facing with the interior filled with concrete. The foundations of the abutment walls must be carried to a "sufficient depth to secure a firm support," and they shall rest on concrete.

The masonry in the face walls of the abutments is to be of sound New York or Westchester gneiss, laid in "random coursed work with horizontal beds." These face walls will be connected transversely by cross-walls, at distances of about 15 feet, to be built of rubble masonry, well bedded and laid in cement mortar. Upon these cross-walls will rest the steel or iron longitudinal beams supporting the roadway above.

The masonry in the piers from one foot below low water to the springing of the arches, shall be of granite laid in horizontal courses of 2 or 3 feet thick, rock-face with 4-inch rusticated draft on horizontal joint and corners; the interior will be of concrete. The caps will be granite and the cornices of bush-hammered work. Above the arch-spring the piers will be laid with quoins of granite, quarry-face, 4 and 6 feet long alternating, and projecting 2 inches from the wall face with a 3-inch draft on the arrises. Between the quoins the facing will be of the before mentioned local stone, in 12 and 18 inch courses, with one-half inch joints and random-coursed work. The interior will be filled with rubble masonry laid in cement mortar; cross-walls divide the interior of the pier, above the arches, into six pockets or wells.

The sidewalks, 15 feet wide each, will be laid with 3-inch bluestone, laid in cement mortar, with curb and gutter stone of the same. Between the beams resting on the walls before mentioned will be turned jack-arches or buckle-plates according to location, and on these will be laid 2 inches of concrete, and above this additional concrete crowning 6 inches at the center covered by one inch of Trinidad asphalt and sand. Over the asphalt is then put 2 inches of clean sand, upon which is placed the granite paving.

The specifications for the superstructure state that the arches are to have a clear span of 508 feet, with a rise of 90 feet and a depth of arch-rib of 13 feet. Each span will have six arched ribs spaced 14½ feet center to center. Each rib will be formed of a plate web properly stiffened and of flanges of plates and angles, with all parts of the ribs mild steel. These ribs must be united by a system of wind bracing on the line of each flange and by a system of sway-bracing between all the ribs



THE PROPOSED HARLEM RIVER BRIDGE.

ON ADOPTED PLANS OF THE HARLEM RIVER BRIDGE COMMISSION.

at the panel points; these latter systems to be either of iron or steel.

The vertical columns supporting the floor-beams are to be of shaped iron, latticed; they must be stiffened transversely by sway-braces. The arch ribs may, at the option of the designer, be pivoted or fixed at the ends. For pivoted ends the bearing pressure must not exceed 5,000 pounds per square inch of effective bearing surface, which latter must be of steel. For fixed ends the anchorage must have a resistance of at least three times the overturning forces.

The floor shall be formed of cross-floor beams at intervals of about 15 feet, with longitudinal floor beams and a floor surface of buckle plates. The cross-floor beams will be riveted girders of plates and angles of mild steel, the longitudinals of rolled iron or steel beams, and the buckleplates of steel or iron 3 feet square and at least ⅜-inch thick riveted to the longitudinal beams and to each other.

The floor and its supports must be proportioned to carry a dead-load of 225 pounds per square foot of bridge floor, inclusive of its own weight, and either of the following live-loads; (*a*) a distributed live-load of 100 pounds per square foot of bridge floor; (*b*) a twenty-ton road-roller of the ordinary dimensions placed in any position on the roadway. The arches to the main spans shall be proportioned to carry their own weight, assumed at 15,000 pounds per lineal foot arch; an assumed load of floor and paving equal to 18,000 pounds per lineal foot of bridge; a live-load assumed at 8,000 pounds per lineal foot of bridge, and a wind pressure of 1,200 pounds per lineal foot of bridge distributed in proportion to the exposed surface.

The allowed maximum strains produced by any combination of above loads shall not exceed:

Tension or compression in the flanges of the arch ribs per square inch of gross section	15,000 lbs.
Tension in same per net section	18 000 "
Tension in flanges of cross floor beams per square inch of net section, for iron	10,000 "
Same for mild steel	12,000 "
Tension or compression, extreme fiber of longitudinal beams, for iron	12 000
Same for steel	15,000
Tension, lateral and sway rods, iron	15 000
" " " " " steel	20 000

The vertical columns are to be proportioned by the following formula.

$$P = \frac{10{,}000}{1 + \frac{L^2}{30{,}000\ R^2}}$$

In which P = allowed compression per square inch of cross section.

L = length in inches.

R = least radius of gyration in inches.

No compressive member, however, shall have an unstayed length exceeding forty-five times its least width.

As to quality of material, the tension members of iron shall stand a test of 48,000 pounds ultimate strength per square inch on sections not over 4½ inches in area, and stretch 12½ per cent. in their whole length. Bars of a larger section will be allowed a reduction of 1,000 pounds per square inch for each additional square inch of section down to a minimum of 46,000 pounds per square inch. All steel for arch ribs, girders and tension rods shall have an ultimate strength of 62,000 to 70,000 pounds per square inch, with an elastic limit not less than 32,000 pounds, and a minimum elongation of 18 per cent. when measured on an original length of 8 inches. Steel for rivets shall have an ultimate strength per square inch of 56,000 to 64,000 pounds with a minimum elongation of 25 per cent.

The contract is to be let in one lump sum for the foundations, masonry and roadway, and the steel and iron-work in another lump sum; but if the entire work is awarded to one bidder then the entire contract shall be for one lump sum covering all charges whatsoever.

The entire masonry is to be completed by January 1, 1888; and the entire iron-work or steel by June 1, 1888. The Chief Engineer for the Commission is Hon. Wm. J. McAlpine, Cotton Exchange, New York City.

The Manufacture of Fire-Brick at Mount Savage, Maryland.*

BY ROBERT ANDERSON COOK, A. M., MOUNT SAVAGE, MARYLAND.

The subject of refractory materials occupies such an important position in all metallurgical works, and particularly in those of iron and steel, that any data concerning it must be of interest to the metallurgist. No apology is needed, therefore, for this attempt to describe the mining of fire-clay and the manufacture of fire-brick at one of the largest establishments in this country.

Mount Savage is a small village situated in the northwestern part of the Cumberland coal basin, on the Cumberland & Pennsylvania Railroad, and at the foot of Savage mountain, from which the village takes its name.

Fire-brick have been manufactured here almost, if not quite, as long as in any place in America; and as the brick are still shipped to nearly half the States in the Union every month, the manufactory is probably the most generally known.

In the year 1837, a company was formed called the Maryland & New York Coal & Iron Company. It built two blast-furnaces, the ruins of which still remain. It was in the construction of these furnaces that the first fire-brick made here were used; and though the iron works ran but spasmodically, the brick works have been in constant operation ever since.

From 1837 until 1846, the Maryland Coal & Iron Company, from then until 1848, the Lochiel Iron Co., and from 1848 until 1864, the Mount Savage Iron Co., ran the brick-works, and in connection with them the blast-furnaces and extensive rolling-mills. In 1864 the Consolidated Coal Co. ran the entire works; and it was not until 1868 that the iron manufactory was given up, with the exception of the foundry. In 1870 The Union Mining Co., of Allegheny county, was formed, and is now engaged in the manufacture of bricks from the mine which was opened about 1841.

The Clay Mine.—The mine is situated on the south side of Savage mountain, three miles from the works by the tram-road. The bed of clay crops out along the summit of the mountain, and runs nearly northeast and southwest. The only other mine on this bed is a very small one, two miles southwest from that of the Union Mining Co. The clay from this mine is brought to Frostburg, where it is manufactured into brick.

The large bed was first opened on the outcrop, and for a number of years all the clay was dug from open pits, and hauled at great expense down the mountain in wagons to the works. Finally, when this method of mining had been carried on as long as was economical, the mine began to be worked systematically, and levels were driven on the outcrop, on one side, wherever it could be reached by reason of the formation of the hill. From this level, galleries were driven at an angle up on the bed, clear through to the old workings. Chambers were driven out from these galleries, connecting the galleries as often as the nature of the ground would permit. When these chambers are all driven through, that part of the mine is robbed of as many of the pillars between the chambers as it is practicable and safe to remove. There are several of these levels driven, the last one about 100 feet below the next above, and as the dip is about one foot in every four on an average, one can calculate on the amount of clay each level will yield. From the present outlook there is enough to run the works for a great many years.

At the time this more systematic mining was begun, some cheaper mode of transportation was also sought. First, a wire tram on the English system was tried, consisting of an endless wire rope, with buckets of the capacity of fifty pounds, and a stationary engine of eight-horse power at the bottom. This plan involved much trouble, and never could supply the requisite amount of clay; and when winter came, with its extreme cold and snow, the plant was practically useless. Then the regular three-rail incline was adopted, which is in common use in this coal region, and which has worked well ever since. The only peculiarity of this incline is its great length. It is a mile and a quarter long, and the rise from the bottom to the top is 1,240 feet. Six cars run upon it at a time; three loaded ones coming down haul up the three empty ones. The rope is of steel, five-eighths of an inch in diameter, and runs over two shrive wheels 12 feet in diameter, on each of which is a band brake. One man to run these brakes, two men to load, one man to unhook at the bottom, and one to look after the rollers on the incline, are all that are necessary to run 100 tons of clay per day. The cars when empty weigh 1,800 pounds, and two tons of clay are loaded on each car. It takes seven minutes, on the average, to run one trip. This is said to be the longest gravity road of its kind in the world. From the bottom of this incline, the loaded cars run down by gravity on a tram-road to the brick-yard, and the empty cars are hauled back by mules to the foot of the incline.

The bed of clay lies at the very bottom of the coal measures of this basin. On top of the clay lies an 8-inch bed of coal; beneath it lies from three to four feet of shale; and then comes the conglomerate rock which marks the boundary of this basin. The bed of clay varies from eight to twenty feet in thickness.

The clay is divided into two varieties, the hard and the soft; and these are distinguished by their physical properties. One of these varieties is of a medium gray color, shading almost to black. This clay is very hard, and rattles like crockery when thrown into the chutes. It has a distinct, though not regular, conchoidal fracture; it is non-plastic unless ground to an impalpable powder, and does not crumble much when exposed to the weather in heaps, being affected for only about 3 or 4 inches from the surface though exposed for years. In parts of the mine, this clay, when finely broken, is sharp enough to cut one's hands.

The other variety is a very plastic clay, of much ligher color, weathering very rapidly, and in one seasons exposure crumbling to powder.

The peculiarity of this deposit is, that the two clays are so inter-mixed in the same bed, and in such a way, that in the present development of the mine there is no accounting for the difference in structure of the clay. In one place the bed will be full from roof to floor of hard clay, and in another place, within a few feet of the former, the clay will all be soft. These sudden changes cannot be accounted for. Usually, the soft clay lies on top of the hard, and acts as a sort of protector for it, keeping off the coal-water. In some places, again, there is a gradual change from one to

*Transactions of the American Institute of Mining Engineering. Pittsburg Meeting, February, 1886.

the other, from hard to soft and back again; and often the hard clay lies between layers of the soft. This is what causes the difficulty in the mining work and makes it seem irregular; for where the hard clay is struck, small pillars and large chambers are made, and *vice versa*.

The impurities in this clay are much the same as in all other clays, except that they are fewer and smaller in amount. There are some balls of iron-ore found in the bottom of the bed, but these can readily be seen. The most objectionable impurity is iron pyrites, which is found in the slips of the soft clay, and particularly in the casts of roots in that variety. The detection of this iron pyrites is impracticable until after the bricks have been subjected to the intense heat of the kiln, when discoloration is shown in spots on their surfaces.

The coal which is used at the works is obtained on the property from the coal measures above the clay. It is mined from a vein 22 inches thick, and is brought down to the head of the tram-road by a short incline, and there it is run in with the clay, and trains made up of both are run down to the brick-yard.

A good many analyses of this clay have been made, at various times and by different chemists, but it would not be safe to take any one of the various results as a test, for the difference in them is probably due as much to the chemists as to the samples. The following is an average of several results, which will probably give as accurate an analysis as one could obtain:

Silica,.....	55.75
Alumina,.....	33.23
Impurities,.....	2.06
Water,.....	10.37

The Brick Manufacture.—The plant for carrying on the manufacture of brick here is as complete as can well be found. There is a foundry and a machine-shop where every machine used in the manufacture of the brick is made. The rollers and pans for crushing the clay, the tempering pans, presses (hand and steam), are all made entirely at the works, so that all varieties of shapes of brick can be made and pressed. The works are complete for turning out all brick from the smallest 9-inch shape, weighing three pounds, to the largest glass-house shapes, weighing 3,000 pounds.

The kilns for calcining the clay are built of brick with a boiler-iron shell. They are 15 feet high and 8 feet in diameter, with fire-holes a few feet from the bottom. The top is dome-shaped, with a chimney from the center having a damper on top. The clay is charged in through a hole near the top of the dome, and is drawn out at the bottom of the kiln on iron plates, through two drawing-doors, one on each side of the kiln, twenty tons being the daily product of one kiln.

"The most important constituent is the calcined clay or chamotte. This will not shrink, and possesses the power of union in the greatest possible degree."* These two important qualities have more to do with the production of a brick, regular both in size and in quality, than any other features in the material or process employed.

Another advantage in calcining clay is that it enables one to throw aside any clay in which there are impurities that may have been previously overlooked, since these are much more easily seen when the clay has been burned. The proportion used must, of course, vary with the size of the brick or tile, and the particular use for which it is intended.

From the crushing-pan, which consists of two heavy revolving grates, the clay goes by an elevator, through the screens, into a hopper above the tempering-pan. This pan is on the same principle as that used in crushing, except that, instead of having a grate-bottom, it is of solid iron. The clay is carried to the tables of the various mouldings by an endless belt. The brick are all moulded by hand. They are dried on a brick floor, heated by flues running the whole length of the yard. When dry enough, they are pressed in hand-presses unless they are too large. In that case they are made in a steam-press at first, and smoothed up by hand when dry enough. No machine for moulding is used here, though it was tried at one time with more or less success, but the bricks were never as even and regular as they are now.

After the bricks are moulded, pressed, and thoroughly dried, they are ready for the kilns. The kilns used are of two varieties. One is the regular down-draught kiln, rectangular in shape with fire-holes on two sides, and a flue in the bottom, running the whole length of the kiln, having a direct connection with a stack at one end, which gives the draught. Breasts of bricks are built in front of the fire-holes to protect the brick nearest the fire from direct contact with the flame.

The other is a gas-kiln, having some of the peculiarities of the Hoffman, in that solid fuel is used, and also the heat from the burning bricks dries the brick gradually. In these two points it resembles the Hoffman kiln, but it differs from that in not being a continuous kiln, being rectangular in shape, instead of elliptical, and using gas for its principle fuel. The kiln is two hundred feet long, forming a tunnel with rows of holes through the roof for the admission of the gas and coal. These holes are provided with iron caps which can easily be removed. Along one side of the kiln is a flue leading to the stack, and flues leading out at right angles to this run across the kiln, so that the gas comes in at the top and goes out at the bottom. At one end of the kiln are fire-holes, and the brick are set at this end first, and the kiln set full for a certain distance. Care is taken to leave a clear space under each hopper in the roof, so that the fuel can go to the bottom. Iron plates are used to shut off the brick already in the kilns from the men setting the bricks, and these plates are made tight by smearing them with clay, making of each section a chamber by itself. The fires are lighted, and burn very slowly for a time until the first brick are gradually but thoroughly heated, when some fine coal is dropped in through the roof. The gas is then admitted through the holes in the roof, and the fire-holes are tightly closed, only enough air being admitted through the red hot bricks for the combustion of the gas.

The gas-producer is on a truck, which runs on a track the full length of the kiln, and as fast as the brick are burned it is moved along the kiln. As it progresses the iron plates are drawn out and placed further up the kiln, adding new chambers. The brick are very gradually dried in this way, and a greater heat is developed with less cost in this kiln than in any of the down-draught kilns, which are heated in the ordinary direct way with coal.

This kiln will hold three hundred thousand brick, and it takes thirty days to burn it from end to end. One man and a boy are all that are necessary to run the producer, except when it must be moved.

The combined product of the works amounts to the equivalent of something over twenty thousand nine-inch bricks per day.

The writer has been employed by the Union Mining Company in making such tests as seemed to be desirable to keep the brick up to the best form for any change which might take place in the market. It was not intended that other clays should be bought to mix with those found here; and from tests made here of brick from other places, and calculations from analyses of other clays, it is doubtful if any could be procured which would be of any advantage in the general run of fire-brick work.

For the calculations in getting at the value of a fire-clay from its analyses, the formula used was one given by a German chemist, Dr. Carl Bischof, who is a recognized authority on the subject of refractory materials, and whose investigations on the subject have been carried out and verified to some extent in this country. He divides the clay into two parts, the silica and alumina constituting the refractory part, and the impurities the fluxing part. Dr. Bischof, in this formula, uses the impurities as a whole, but in another he divides them according to their relative strength as fluxing agents.

Taking the alumina divided by the total impurities as a dividend and the result of the silica divided by the alumina as a divisor, the quotient will be a measure of the refractoriness of the clay as compared with that of another clay treated in the same way. Calling *R O* the impurities, the formula will be as follows:

$$\frac{Al_2O_3}{RO} \div \frac{SiO_2}{Al_2O_3}$$

As small a difference a 0.05 between the quotients thus obtained for two different clays indicates a difference in refractory quality which, other things being equal, will show itself in a furnace-test.

These calculations are of great use in comparison of different clays, but the result one might expect from them may be entirely changed when the clays are made into brick. The physical qualities of all clays must be tested before an absolutely perfect comparison can be made. A sample of the same clay being used by two different brick-makers, yet the one brick made from it may not be as refractory as the other, though the sample may have been thoroughly mixed; for if in one case the clay be coarsely, and in the other finely, ground, the coarse one will stand a great deal more heat than the other before it vitrifies to a homogeneous mass.

This has been observed before; and the writer has found it perfectly true as regards this clay, that the more finely it is ground, the less refractory it becomes. At the same time, the more finely it is ground, the stronger and harder the brick becomes, the more abrasion it will stand, and the less likelihood there is of its being broken in handling. Though refractoriness is an essential of fire-brick, yet it is not the only one.

For the various positions in which the brick are placed, and the duties they are expected to perform from the upper part of a blast-furnace where the heat is low, and the abrasion of stock is the greatest element in the destruction of the brick, to the ports of an open-hearth steel furnace, where intense heat is the most destructive element, particular mixtures of clays should be made, to get the best results from raw materials.

The greatest trouble of a brick manufacturer, is that he cannot be sure for what purpose the brick will be used, or in what position in the furnace they will be placed. Another trouble is to find out where the fault lies, when complaint is made. This is almost impossible. It may be in the construction of the furnace, or in bad bricklaying, or in the grade of the brick, or that the brick were not hard-burned. And if a sample lot of brick is sent to a mill to be tested the chances are that when the superintendent is asked how the brick stood the test, he will have forgotten all about them.

* *Die Feuerfesten Thone*, von Dr. Carl Bischof, Leipzig, 1876, p. 168 (1).

The only way for a manufacturer to test the brick, is to build a furnace and test them himself, and to do this under as nearly as possible, the same conditions as those under which they will be used in practice.

The furnace used by the writer for making such tests had nearly the form of a puddling-furnace, One-half of it was built of one mixture and the other half of another, running through the furnace from end to end. Bridge-wall, roof, side-wall and neck would show how the brick stood in each positon. From the results of the tests a fair comparison could be obtained of the value of the brick. The draught was a direct one to the foot of a large chimney, and the coal used was a mixture of the best Cumberland coal and our own. A brick of the mixtures used in building the furnace was taken as a standard. One of these bricks, with another, either of some other mixture, or some brick which we wished to test, were placed side by side in the neck of the furnace, which was then fired as hard as possible for a certain length of time. When the furnace had cooled off, the bricks were removed, and the effect carefully noted, particularly as regards shrinkage and vitrification, and the effect of the heat on the furnace was also noticed. The heat in thirty-six hours was intense enough to vitrify any brick, but not enough to destroy them.

As the demand now is for a hard-burned brick, the difficulty of spotted bricks arises. These are bricks which appear to be of poor quality, for though a clay may not contain more than one per cent. of oxide of iron, yet, if it is exposed to a great heat, these spots will show; and, at present, buyers, with the exception of a few who have learned their value, will not take spotted bricks. All the brick from other places, which the writer has tested, will when exposed to our greatest heat, show some spots, although as they come out of an ordinary kiln, they are free from spots.

The two peculiarities which have made this fire-clay so famous, are its freedom from impurities, and the fact that it contains such a proportion of silica to the alumina that the brick, after they have been hard-burned, will swell a little instead of shrinking, no matter how much they are heated.

The care which the company has taken in preparing its product for market, has borne profit in the gradual increase of its sales from year to year.

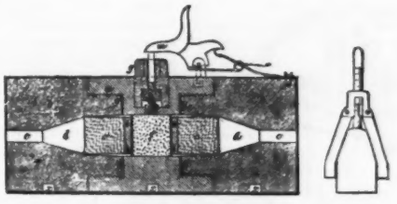
Apparatus for Measuring the Force of Explosives.

This apparatus, the invention, of M. Guttman, rests upon the same principles of action as the one previously used in the experiments at Meudon made by Messrs. Montluisant and de Reffe; that is to say, the effect of the explosion is measured by the deformation of a cylinder of lead forced into a conical matrix. One of the objections made to this method is that in testing cannon powder only imperfect results are obtained, because this explosion does not act simultaneously throughout the whole mass, and the deformation is in consequence inferior. To meet this objection M. Guttman uses only light charges in a closed space, which will, he thinks, insure the quick ignition of all the grains, and to better distribute the effect he uses two cylinders instead of one.

The apparatus is made up of a middle piece *a*, forming a hollow screw (see Fig. 1.) and two end pieces *b* containing the matrices; the whole made of tempered steel. The pieces *a* and *b* have a length of 100 millimetres, the end-pieces having a screw *y* twenty-five millimetres long, and cylindro-conical chamber *c*, *d*, *e*, which communicates with the exterior by the opening *E*. The diameters of these chambers are as follows: For the almost cylindrical portion, *c*. 33.5 millimetres at the front, and 31.5 at the back end, and 29.5 millimetres long; the conical portion *d* has a diameter of 10 millimetres at the apex and the neck *E* the same. The central chamber, *f* is 45 millimetres long and is practically contained within the part *a*, and is intended to hold the charges. For firing the charge, a small nipple is screwed into the upper part of the firing chamber and on this is a hammer *i* which has a play of 2 millimetres and is contained in a supplemental piece screwed into *a*.

The three principal pieces are tied together by a common collar fitting in the grooves *x*, and the gas is prevented from reaching the screw-threads by the copper washers *y*.

In charging the apparatus, the piece *b* is held



Guttman Apparatus.

vertically and the lead cylinder is introduced, and upon this is placed a steel plate *k*, and above this a disk of pasteboard *l* completely closing up the chamber. The charge is then put in place and the operation reversed for putting on the second end-piece *b*. An ordinary cap is put on the nipple *h* and exploded by the hammer *m*. The gas can only escape by nipple *h*, and the hammer by bearing against the shoulder in the tube *g* stops it completely. The explosion is unaccompanied by any noise, excepting a slight whistling, which gives notice that the cap has exploded and the gases are being condensed inside.

M. Guttman recommends the use of the apparatus under water, so that the residue of combustion, which might otherwise penetrate into the threads of the screws, detach themselves easily and the apparatus can be opened without difficulty. It is equally prudent to fire the charge from a distance, as the nipple and the tube *g* burn up rapidly and may sooner or later fly out.

The cylinders deformed by the explosion bear the numbers 1 and 2 which are cut in the conical chambers *d*. These cylinders are measured with a caliper shown in Fig. 2, which is graduated to the tenth of a millimetre.—*Le Genie Civil.*

Prof. Powell in Defense of his Bureau.

The last pages printed of the testimony taken by the joint commission of Congress to study the organization of the scientific bureaus of the Government contains a letter from Professor J. W. Powell, Director of the Geological Survey, justifying the existence and explaining the work of the institution of which he is the head, written in reply to the letter of Prof. Alexander Agassiz to the commission, already made public. With respect to the claim that the work of the survey falls within the limits of individual investigation, Prof. Powell makes a comparison between what the general and State Governments have done for geological research with the work accomplished by private enterprise. A hundred years ago a carefully considered plan of land surveys was instituted, which was intended to form the basis for all cadastral maps and subserve all industrial and military purposes, and later, under the leadership of Lewis Cass, a geologic survey was ingrafted upon the system and eminent geologists were employed for the work. Had the plan been executed according to the original intent, the country would now have completed by far the greatest and most important geographic survey on the face of the globe. Unfortunately a vicious contract system under which preferred bidders were to do the work was incorporated in the plan, entailing great extravagance on the one hand and such deterioration on the other that it finally subserved the single purpose of parceling out the lands. This system of survey has cost up to the present time $35,000,000, and it will always be a matter of profound regret to scholars and statesmen that the grand purposes for which the surveys were primarily organized were not fully realized. These facts are recalled to illustrate the statement that topographic surveying has been recognized as the proper work of the General Government ever since the adoption of the Constitution and geologic surveying ever since the development of the science. for a long series of years the Government has provided for general topographic and geologic surveys, with various purposes in view and under various organizations, having expended in the work considerably more than $6,000,000, the results of which have been made accessible to the public in maps and works on general and mining geology and paleontology. State Governments have also made large expenditures for topographic and geologic surveys, aggregating more than $4,000,000. It may be, Prof. Powell says, that Mr. Agassiz in his condemnation of the work in the Comstock, Eureka, and Leadville Districts referred chiefly to the fact that the work was concentrated in them rather than distributed more generally elsewhere, and that it was not his purpose to condemn geologic work at large. If such was the case his statement must have been made with little consideration of the facts. From these three districts more than $444,000,000 of gold and silver bullion have been taken, and hundreds of miles of shafts and galleries have been constructed. Prof. Powell further urges in reply to Prof. Agassiz that it would seem to be wisdom on the part of a Government designed to promote the welfare of the people to provide for investigations in those fields most vitally affecting the great industries in which the people engage; that one national survey is more efficient and economical than many State surveys: that the plant for geologic investigation is too expensive for private agencies; that the results of local investigation are of general value to many districts, and a knowledge of the geology of one locality must be derived from an examination of many other localities, and that all Governmental research stimulates, promotes, and guides private research.

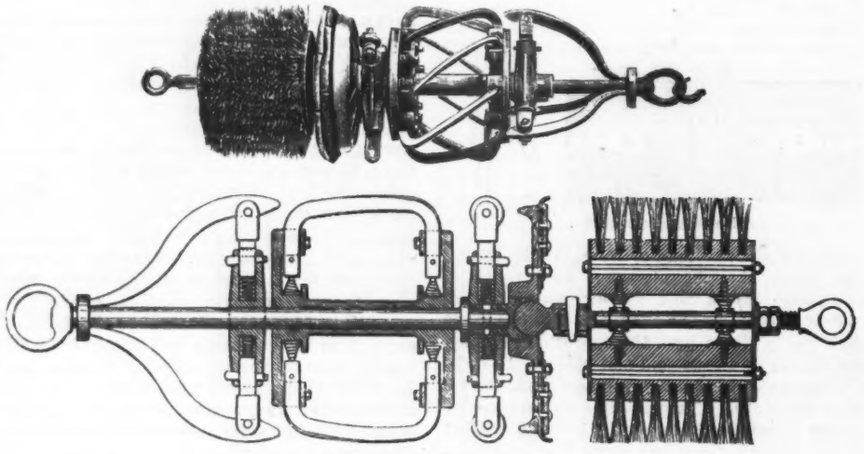
THE *British Australasian* says:—"The Hawkesbury Bridge, New South Wales, the greatest piece of bridgework in all Australia, has been secured by an American firm, the Union Bridge Company of New York, and thus £327,000 worth of work has been lost to the engineering trades of the mother country. It is a bad sign for the home supremacy in trade that American firms and German firms can at this juncture step in and undersell her iron and steel manufactures in Australasian markets, and that not alone in rails and locomotives, but in bridgework as well. Australasians would very much have preferred to have seen as a record to after years a British name recorded on the Hawkesbury Bridge."

ENGINEERING NEWS, Three Months, One Dollar and Fifty cents.

Water Pipe Scraper.

The furring up of water pipes is a common occurrence, and this occurred at Bradford to such a serious extent in the 18in. main connecting two reservoirs as to lead to the demand for some means of clearing it out. The result of the demand was the manufacture by Mr. Clayton of a scraping apparatus which, placed in an empty pipe, is driven by the pressure of the water admitted at its back.

The apparatus consists of a central spindle carrying in front a tapered nose made up of steel bars, designed to lead the scraper past any branch pipes, and generally ease its passage along the pipe. The back ends of the guide arms rest against the axis through the medium of helical springs, so allowing for such accidental obstructions as chaplets, etc.



The Clayton Water-pipe Scraper.

Next upon the spindle is placed the scraping portion proper, consisting of two discs of cast steel, in which are held the spirally disposed scrapers, of steel preferably eight in number, and also having a spring contact with the central spindle. The spirality of the scrapers is so arranged that projected longitudinally —*i. e.*, parallel with the central spindle —they circumscribe the circle. Beyond the scrapers and forming the back carrier is a triple spider carrying friction rollers on spring fitted arms, and at the back of this guide is the driving piston of cast steel, with segmental packing discs of stout leather to form a fairly watertight joint. Coupled to the tail of the machine by a ball joint is a stout cane brush. The machine is introduced into the pipe to be cleaned at a bolted flange, and the flange being replaced water is admitted behind and forces the scraper along—at Bradford—at about the running speed of a man. At intervals of two or three hundred yards men are stationed above the pipe line, who listen for the scraper by means of stethoscope rods of pine applied to the ground and to the ear.

Should the machine stick fast, which has not yet occurred, its position would be located to at most about a couple of hundred yards, and as the watchers take up the stick and run as soon as the scraper passes them, and follow into to the next station it can generally be localisedto a yard or two. Some lumps of joint ing lead were brought out. Large volumes of ochreous mud have by this means been removed from 7½ miles of pipe and the supply capacity fully brought up to the 18 in. bore, the delivery being increased by nearly 500,000 gallons daily.

We may add that the machine is so flexible that it readily passes quick bends of 90 degrees.—*Mechanical World*, London.

The Relocation of Old Land-Lines.

Written for ENGINEERING NEWS.

BY JOHN L. CULLEY.

An old surveyor in my section of the country was one time about to survey a certain piece of land, and the proprietor proceeded to instruct him about thuswise: "You measure from Capt. Smith's S. W. corner fence post east 523.42 feet along the road and set my stake. Then you will begin at Clark's S. E. corner stake and measure west on the road 832 feet and set a stake at my S. E. corner, etc, etc." The man of lines and angles meekly listened, but in the end remarked "Mr. B., I am here to restore old lines, not to make new ones." The old surveyor in his answer stated the only theory that should be adopted in running out old lines, and his position is sustained by law and equity.

There are three rules for the restoration of old lines:—(1) Monuments; (2) testimony of the oldest inhabitant; (3) by the dimensions and angles named in the instrument of conveyance. These three rules can be defined as follows:—

(1) *Monuments.*—These may be permanent or temporary in character. Stones, reference trees, buildings, etc., are classed as permanent, while other trees, fences, long travelled roads, sidewalks, etc., are temporary. A line can, of course, be exactly located from permanent monuments, while those of a temporary character will indicate with more or less exactness the line desired. Plats are frequently recorded without noting monuments, or all of the stone monument are from carelessness or some other motive lost, and it is the surveyor's duty to restore them. In cases of this kind the following method of treatment has been persued by the writer with success and satisfaction:

By years of careful observation it has been discovered that fences, as a rule, are built exactly or nearly so on their correct lines, and that any departure from the line is the exception to the rule. Now if a plat of a subdivision or of several tracts of land can be constructed on a sheet of drawing paper, it is held that the surveyor should be equal to the task of actually running out these dimensions and angles on the ground, and this conclusion is true and susceptible of proof. To apply it, next proceed to your district and carefully measure the distances between the fences or building, supposed to be on lot lines, on either side of the road or street. The fences or buildings correctly located will agree very closely with the true distance that they should be apart, and you will soon discover a practically uniform percentage of surplus or shrinkage to the recorded dimensions, which applied to other lines will locate them.

This process is capable of very rapid application; it is of value in unraveling complicated and mixed-up lines, and useful in restoring the location of old lines; but it should only be applied when all other expedients have failed and only then with great caution.

(2) *The testimony of the oldest inhabitant.* Properly considered, this means the most reliable inhabitant, for age alone does not render testimony valuable, or final, the reverse is too often the case. The phrase really means the testimony of the most intelligent observer to be found who was present when the lines were originally run.

(3) *Deed Description.*—When this description is taken as a last resort in restoring lines, due consideration should be given to the care with which the instrument of conveyance has been drawn up. And in case of doubt as to the proper amount of care observed in this particular, the instrument should be compared with its predecessors and the description corrected accordingly. Unless so mentioned, the dimensions narrated in the deed are never to be regarded as strictly exact; but if mentioned as exact, the surveyor has no alternative but to put them on the ground as described. It is always presumed, unless proof is advanced to the contrary, that throughout the original survey the surveyor used one length of chain only, and this chain-length should be determined by the measured length of the deed distance between two permanent, indisputable points. As many such comparisons as possible should be made. If the results show about the same percentage of surplus, it is safe to conclude that the original chain-length is determined, and the remaining dimensions also determined.

If there is no great variation in the results, the average percentage of surplus can be used for the other lines. But if in several measured lines between fixed points, one or two dimensions have unusual variations while the others are uniform, these abnormal variations should be left out in determining an average percentage of surplus. The inference is strong that the line showing a descrepancy as compared to the others was incorrectly measured originally. When the variations between the recorded and actual distances are very variable in their relative lengths, this process of restoring lines will have to be abandoned.

The case will be very unusual where some angle points can not be determined by monuments or living witnesses; and the careful consideration of the deeds of the property and that adjoining will doubtless assist. A map, drawn to a large scale, will often be of value. Recorded distances will take precedence of angles when the deed indicates them by bearings; but if the angles are given without reference to bearings, indicating that they were actually and accurately observed in the original survey, the angles noted take precedence of distances in determining the angles between several courses.

More than on anything else, the restoration of an old survey depends upon the correct judgment of the surveyor, and his experience and quickness in grasping all the evidence bearing upon the case.

DANGER OF WOODEN SHEDS.—In the destruction by fire of the pier sheds of the Monarch Steamship Line, another warning is had of the danger of using combustible materials in structures of this character. Within a few months three fires have originated in frame buildings on the wharves, mostly used for housing merchandise, entailing an aggregate loss of near $1,000,000.

American Society of Civil Engineers.

MARCH 17, 1886.—Vice-President Thomas C. Keefer, in the Chair.

A synopsis of a paper by DESMOND FITZGERALD, M. Am. Soc. C. E., on *Evaporation* was given by the author, and the subject discussed.

The paper gives a discription of practical results and a theoretical discussion. It alludes to the many branches of meteorological work, in which experiments must be made to arrive at correct conclusions. The author presents his conclusions as to the natural evaporation from water surfaces. His observations on evaporation at Chestnut Hill Reservoir, Boston, Mass., began in 1876, and were continued until 1882. On examining these experiments, with the idea of compiling a paper, he found that more accurate experiments were necessary, and in 1881 he devised an apparatus to automatically plot a continuous profile of the evaporation on a sheet of paper. A full description of the arrangement of tanks and the measuring apparatus is given. The experiments were principally made in the Bradlee basin of Chestnut Hill Reservoir, which covers an area of eighty-five acres, and is about 20 feet deep near the center, where the tank was located. The tank was 10 feet in diameter and 10 feet deep, made of staves of wood, spaced an inch apart, and with a thin copper lining inside. This was in the center of a raft 20 x 40 feet, the surface of which was about 10 inches above the water. The raft was anchored in the basin so as to float freely and always present its head, which was arranged to break the waves, to the wind. It was expected that this arrangement would keep the water inside the tank at the same temperature with that in the basin, but it sometimes varied considerably, being somewhat hotter in early summer and cooler in autumn. A maximum difference of ten degrees was observed. Observations were continued during 1883. The emperatures of the air, of the water in the tank and outside, the dew point, the barometer and the force of the wind were also recorded. On at least one day in each mouth hourly observations were made.

The three important factors in evaporation are, the temperature of the evaporating surface, the force of vapor in the air and the velocity of the wind. The maximum evaporation occurs on a cool day, which has been preceded by warm weather; the maximum recorded by the author being 0.61 inch recorded on June 23, 1883, when the mean temperature of the air was ten degrees less than on the preceding day. On December 19, 1883, with the thermometer at twelve degrees Fahr., an evaporation of nearly ¼ inch was noticed. As evaporation during the winter months is so often placed at zero, this is worthy of note. The evaporation from a large water surface is nearly the same day and night; it may be greater on some days from a considerable body of water than from a shallow pool. The author has observed temperatures of the water at the surface of 82.2 degrees and 86 degrees. A shallow pool loses this heat much sooner than a large body, following the temperature of the air more closely.

During two months the Lawrence basin of the Chestnut Hill Reservoir was shut off from the city supply for the purpose of making direct measurements of the actual evaporation from a large surface. From September 1st to 22d the evaporation from the reservoir was 3.83 inches, and from the tank in the Bradlee basin 3.87 inches. The evaporation from the tank was therefore taken as representing very closely that of the reservoir. In the winter of 1878-79 the author made experiments on winter evaporation, the general result being 0.02 inch per day for the winter average. Many comparative experiments between snow and ice evaporation, showed that ice will lose twice as much weight as snow in the same time. Evaporation from ice is believed to follow the same laws as that from water. The temperature of the surface of ice does not follow that of the air any more than that of water does.

The actual monthly mean values of evaporation observed were submitted to a mathematical computation by Bessel's Circular Function, and the following table, showing the observed results and the mean curve of evaporation, was presented:

Month.	Observed evapor'tion.	Mean curve by formula.	Per cent.
	Inches.	Inches.	
January	0.90	0.98	2.51
February	1.20	1.01	2.58
March	1.80	1.45	3.71
April	3.10	2.39	6.11
May	4.61	3.82	9.76
June	5.86	5.34	13 65
July	6.28	6.21	15.87
August	5.49	5.97	15.26
September	4.09	4.86	12.42
October	2.95	3.47	8.87
November	1.63	2.24	5.73
December	1.20	1.38	3.53
Total	39.11	39.12	100.00

Total evaporation for a year, 39.11 inches. The computed curve corresponds very closely with the mean temperature curve.

The author then considers other experiments on evaporation. In this country those by Rev. Samuel Williams, in 1772, the Croton Experiments made by B. S. Church, M. Am. Soc. C. E., and those made at Boyd's Corner by J. J. R. Croes, M. Am. Soc. C. E.; in England, those of Mr. Charles Greaves, C. E., Mr. Miller and Mr. G. Dines; in France, those of Mr. A. Salles, and of the engineers of the Ponts et Chaussées; and in Russia the extensive experiments of Mr. A. Wild, which are discussed by Mr. Stelling.

Without presenting an extended treatise on the theory of evaporation, the author describes the principal facts which it is important to understand. In accordance with the dynamical theory of the constitution of bodies, evaporation is constantly taking place at a rate due to the temperature at the surface, and condensation is likewise going on from the existing vapor in the air passing into the water the difference between the two processes being what we call the rate of evaporation. The capacity of the air to hold vapor varies with the temperature, so that the same amount of vapor in the air will have a very different ratio to the total carrying capacity at two different temperatures. This ratio is called the relative humidity. At any given temperature there is a certain amount of vapor which will saturate the air, and any surplus vapor must be condensed. This vapor has, as a gas, a certain pressure, tension or force dependent entirely upon the temperature, and which may be expressed in inches of mercury. Very accurate tables of the maximum force of vapors for different temperatures have been given by M. V. Regnault. It is upon the amount of vapor in the air that the rapidity of evaporation largely depends. The vapor forming at the surface of water is of the maximum force due to the temperature of that surface. The rate of evaporation depends upon the difference between the maximum force of vapor due to the temperature of the water surface and the force of vapor existing in the air, but it bears no relation to the relative humidity of the air. This is because the temperature of the water surface does not follow that of the air even approximately. The practical determination of the force of vapor in the air is generally made by observing the difference between the wet and dry bulb thermometers, but a more trustworthy method is to take a direct observation by means of some condensing apparatus. The principal points to be considered in the study of the vapor of the atmosphere are: 1st, The temperature of the air; 2d, The dew point; 3d, The force of vapor; 4th, The quantity of vapor in, say, a cubic foot of air; 5th, The additional vapor required to saturate a cubic foot of air; 6th, The relative humidity; 7th, The weight of a cubic foot of air at the pressure at the time of observation.

John Dalton was the first to ascertain the true principles of evaporation. The author having been led by his observations to believe that the rate of evaporation was not in exact proportion to $(V-v)$ as generally accepted, made a series of experiments to determine the exact relation. The formula deduced by the author from his experiments is:

$$E = 0.014\,(V-v) + 0.0012\,(V-v)^2.$$

In which E = evaporation in inches per hour; V = maximum force of vapor at temperature of water; v = force of vapor existing in the air.

A number of experiments were made to ascertain the effect of wind, the result being a modification of the above formula into the following, viz.:

$$E = [0.014\,(V-v) + 0.0012\,(V-v)^2]\,1 + 0.67\,w^2)$$

In which w = the force of the wind at the surface of the water.

For an approximate formula, the following convenient forms may be used:

$$E = 0.0166\,(V-v)\left(1+\frac{w}{2}\right) \text{ or}$$

$$E = \frac{(V-v)\left(1+\frac{w}{2}\right)}{60}$$

In the case of his own observations, the author determined by a series of experiments that the velocity of the wind at the surface of the tank was about one-third of that registered by the anemometer, which was located about 30 feet higher.

A series of experiments under the bell of an air-pump was made to determine the effect of barometric pressure, the conclusion being that within the ordinary range of pressure the effect would be hidden by errors of observation; and generally that the influence of the atmosphere on the rate of evaporation is in inverse proportion to its pressure.

In regard to the application of the formula, the author considers that if a sufficient number of accurate observations are made, a very exact result may be reached. The computed result for any given hour is possibly more exact than the observed value.

The author concludes that there is no difference between sun and shade, other things being equal, and that depth has no influence, other than that due to its effect on the temperature of the surface.

A discussion by GEORGE DOWNE on English and American Railroads Compared was read.

JOHN BOGART,
Secretary Am. Soc. C. E.

LITERATURE.

Journal of the Association of Civil Engineering Societies. March, 1886.

CONTENTS:—"The Worcester Sewerage Tunnel," by WILLIAM WHITTAKER; "Elimination of Errors in Field Work," by WILLIAM BOUTON; "Old Bridges under New Loads," by C. M. BARBER; "Topographic Surveys of States," by H. F. WALLING; "The Strength of Some Building Stone," by PROF. JOHN EISENMANN.

Transactions of the American Society of Civil Engineers. January, 1886.

CONTENTS:—"English and American Railroads Compared," by EDWARD BATES DORSEY.

The above important paper was read at the Annual Convention of June 24, 1885, and is now published, together with a supplemental paper read October 7, 1885 We will have occasion to speak of it in another column.

Proceedings of the Engineers' Club of Philadelphia. February, 1886. Vol. V. No. 3.

CONTENTS:—"A Novel Cement Testing Machine," by P. F. BRENDLINGER; "The Adaptation of Steel to Structural Work," by JAMES CHRISTIE; "Recent Specifications as Affecting the Dimensions of Iron Railroad Bridges," by J. S. ELLIOTT; "The Behavior of two Brick Arches," by J. FOSTER CROWELL; "Engineering: its Achievements and its Rewards," by C. W. BUCHOLZ; "The Greathead System of Fire Protection and the Public Supply of Hydraulic Power," by HOWARD CONSTABLE; "The Present Situation of the Interoceanic Canal Question," by J. FOSTER CROWELL

Flow of water in Open Channels, Pipes, Sewers, Conduits etc. With Tables based on the Formulæ of D'Arcy, Kutter and Bazin, by P. J. FLYNN, C. E., author of "Hydraulic Tables," based on Kutter's formula, for Circular and Egg-Shaped Sewers. Van Nostrands' Science Series, No. 84. Price 50 cents.

The above treatise originally appeared in the Transactions of the Technical Society of the Pacific Coast, but is here issued with additions, being practically rewritten. The design of the author is to meet the present extending demand for hydraulic formulæ by presenting in a handy form methods which combine rapidity with accuracy in application, and are as a rule less complicated in form than the old formulæ of D'Aubisson, De Prony, Downing, etc. The book is mainly taken up with the eleven tables, the uses of which are first explained in the text.

Cassell's "National Library" has touched a chord that a more pretentious series might fail to sound. Not only has the public at large proved its appreciation of these delightful little volumes, but it is individually enthusiastic over them, and the publishers are in receipt of letters from distinguished men and women congratulating them on what they have done in this series. Edmund C. Stedman, the poet, writes: "That the Master-pieces of Standard Literature, edited by Professor Morley, printed with good paper and type, in handy volumes of 200 pages, can now be obtained at the price of a dime for each work, is not only a matter for present congratulation. It is more—it is a convincing proof that a system of International Copyright in new works will not debar our people from enjeying all literature that has stood the test of time at a cost within the means of the lowliest reader." Such a series "must do good," exclaims Rev, Phillip Brooks. "We are all your debtors—all those, I mean, who love good books and recognize the importance of putting a wholesome literature within the reach of the people," writes Bishop Potter. President Barnard of Columbia College is "delighted" and "astonished" at the appearance and the quality of the books. Sidney Howard Gay, the historian, regards the series as "a happy thought," and so it is. Harriet Beecher Stowe writes: "I think an effort like yours both a patriotic and a Christian one." And Miss Cleveland, writing from the White House, says: "I heartily admire and approve your enterprise, for the reason that it looks towards supplying to persons of limited means the best literature in a most convenient form." From England Professor Tydall writes: "You are doing your countrymen and countrywomen a beneficent service, by bringing the gems of English literature in this handy form within the reach of the poorest among them." And Henry Irving, the great actor, adds: "The work is an admirable one, which reflects the greatest credit on its projectors, and cannot fail to have a far-reaching range of public usefulness." As for the press, however, its opinions may be divided in the matter of politics, it is as a unit in its opinion of the "National Library," which it regards as the marvel of the Nineteenth Century.

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TABLE OF CONTENTS.

	PAGE
Municipal Engineering	225
Taking Down an Iron Mast	225
The Harlem River Bridge (*Illustrated*)	226
The Manufacture of Fire-Brick at Mount Savage, Maryland	227
Apparatus for Measuring the Force of Explosives	229
Prof. Powell in Defense of his Bureau	229
Water Pipe Scraper (*Illustrated*)	230
The Relocation of Old Land Lines	230
American Society of Civil Engineers	231
Literature	231
Editorial Notes	232
Municipal Engineering	232
The Harlem River Bridge	232
The American Association for the Advancement of Science	232
A Remarkable Book-Making Machine	232
The Council of Engineering Societies on National Public Works	233
Experiments with London Sewage	233
Lighting with Gas Fifty Years Ago	234
Personal	234
American Society of Civil Engineers	235
Engineers' Club of Philadelphia	235
Literature	235
Correspondence	236
The History and Statistics of American Water Works	236
Water	237
News of the Week	238
Market Report	240
Trade Notes	240

IN the preparation of the series of papers on the Municipal Engineering of Providence, R.I., commenced in this issue, we are indebted to Mr. Samuel M. Gray, City Engineer of Providence, who has most kindly had all of the text drawn up under his personal direction and the drawings prepared in his own office. Our readers can therefore accept them as coming from the highest possible authority and as fully showing the features of municipal engineering which have made Providence a model city in this respect. We here again thank Mr. Gray for his personal kindness and congratulate our readers who are to be benefited by his interest in the advancement of this important branch of the profession.

ACCORDING to advices from Hong Kong, Gen. Wilson, who is in China in the interest of a Boston railway syndicate, is now making a survey for a projected railroad along the Grand Canal. Gen. Wilson is said to be doing this at the request of Li Hung Chang and is assisted by a number of officers from the U. S. Steamer "Monocacy."

A WORD to our correspondents sending in drawings may be serviceable to them, and will certainly, if our advice is carried out, save us much trouble.

When a drawing is furnished for photographic reproduction, it should be made with the following conditions kept well in view:—The original should be drawn about three times the size of the intended photo-engraved plate, as the lines of the latter will be much finer by reason of the reduction. The paper used should be white and smooth, the rough surface of Whatman or other paper of like character interferes with the continuity of the lines. The drawing should be made with very black ink in sharp, well-defined lines; fine pen shading should be avoided; it is best to shade only the usual heavier lines on the "shadow sides" or the bottom and right-hand side of the object. All letters and figures should be proportioned with a view to their reduction; firmly drawn, well-defined block letters are the best adapted to work of this kind.

In selecting the size of the original, remember that we cannot devote a full page to any and every drawing that it may be desirable to use. The size in our paper will depend solely upon the importance of the original and the amount of detail it is proper to show. A simple diagram with few letters or figures can just as well be shown in the width of one column as on a half-page. In attaching a scale, this should always be drawn on the sheet so that it may be reduced with it. A scale simply stated is of no value when the size is to be changed.

LIEUTENANT E. L. ZALINSKI has just made a most complete and detailed report to the War Department on the pneumatic dynamite torpedo gun. After describing his original experiments with the Medford air-gun and the deductions made from this preliminary test, he enters very fully into the later types of the same gun; the calibres passing from 2 to 8 inches. He then discusses the firing of torpedoes, their efficiency against ships and the various methods of propelling them. He closes by a summary of the following uses to which this pneumatic torpedo-projecting machine could be applied: As an adjunct to the torpedo defense of a harbor in the fortifications; for the same purpose, but placed in swift moving torpedo-boats; for countermining systems of torpedo defence; as a defence of men-of-war against attacks by movable torpedoes and torpedo boats, and for seige operations by regular approaches. The report is heartily endorsed by Col. Hamilton of the 5th Artillery, who has been intimately connected as commandant of Fort Hamilton with Lieut. Zalinski's experiments.

Municipal Engineering.

In response to several enquiries referring to the practice of adjusting grades at the intersection of blocks, we would answer that this feature, overlooked in the preparation of the original papers, will be discussed later for each of the cities whose practice is or is to be described.

The field covered by this series of papers has been heretofore practically unworked, and while space forbids the minute detail that a full treatise on this subject would demand, we will be obliged to our readers for suggestions and notice of omissions. Our wish and intent is to make these papers of practical value to the full extent of the form in which they must necessarily appear.

The Harlem River Bridge.

In illustrating in this issue the plan upon which the Commissioners are soliciting bids for the erection of the proposed Harlem river bridge, we can not help remarking that it seems to us that all beauty of design has been ruthlessly sacrificed to the requirements of stern utility and severe economy.

We fully recognize the merit of economy in expending public funds; but in this case, if the bridge is actually required by others than those interested in real estate thereabouts, the beauty and importance of the site, and the engineering skill and architectural finish of other structures in the immediate neighborhood, demand something better than bare walls of the cheapest masonry and a pair of metallic skeleton arches shorn of all ornamental detail.

The plan is neither creditable to the good taste and skill of our bridge engineers, nor will it be in any degree an ornament to the city which will be called upon to pay for its construction. If economy is the ruling motive, we pray the Commissioners to still further economise by saving the whole cost of execution of this compromise bridge plan, and wait until they can afford to build one of the bridges for which they have awarded prizes, or some other of equal merit with them.

The American Assoc. for the Advancement of Science.

The 35th Annual Meeting is announced for August 18-24 next, to be held at Buffalo, N. Y., Mr. O. Chanute, the Vice President of the Association and Chairman of section D, on Mechanical Science and Engineering, expresses the hope that the steadily increasing interest and importance of the meetings of this section (first organized in 1881) will attract a large attendance of engineers to the Buffalo meeting. He states the following as among the general subjects which this section considers as within its scope:—Mechanical science in the abstract; mechanical research; problems in engineering of national importance; the education of engineers; the relation of the government to engineers in civil life, and the endowment and organization of mechanical research.

A Remarkable Book-making Machine.

We were never more convinced of the literal truth of the saying that "of the making of books there is no end," than when lately inspecting the working of a perfecting printing press now in operation in Philadelphia.

This press is the invention of H. P. Feister, a most accomplished mechanical engineer, as the perfection and simplicity of this wonderful piece of mechanism conclusively proves. The machine is intended to print and bind pamphlets of thirty-two pages or under; though by a special arrangement this number of pages can be exceeded.

Briefly described, there are in elevation three cylinders, each 8 feet in diameter and about 6 feet wide, and arranged two above one. The rear cylinder carried the electrotyped forms for *four* thirty-two page pamphlets when we saw it at work, and in this cylinder is a most complete arrangement for securing absolute correctness in register, and above it are the distributing and inking rollers. The second and third cylinders are carrier and printing cylinders, with a pair of paper cutting cylinders of small diameter above the second top cylinder.

The printing paper is taken from a continuous roll in the rear of the machine, carried over the type cylinders to the cutter, and by this latter a piece of paper is cut off sufficient for eight leaves of the book, or two leaves for each of four books. We said cut off, but this sheet is not quite detached; at intervals a narrow slip of paper is left untouched, so that the partly cut sheet can still be truly guided down the ribbons of the press-cylinder to the point where the first impression is to be made; just before reaching this point a set of metallic fingers lightly touch the sheet and hold it just long enough to completely tear it

loose from the main roll. The impression is then made as the two top cylinders pass each other at their nearest points, and the printed sheet passes on about to the bottom of the first press-cylinder, when the "fingers" that have pulled it to that point suddenly let go and another set of "fingers" grips the opposite edge or top of the sheet and pulls it back over the top of the lower or *second* impression cylinder. This movement brings the unprinted side of the sheet *up*, and by the reverse motion of the under cylinder carries it again under the type-cylinder and prints the other side, or eight pages.

The sheet now printed on both sides is carried under the lower cylinder to a pasting device, which "prints" a narrow line of paste upon the middle of each sheet, as these sheets are gathered on an "assembling" roll. Back of this last roll is a table with a slot through its center, and on this table, in this case, was laid an elaborately ornamented lithograph cover by the only attendant the machine had. As soon as eight sheets had been gathered on the assembling roll, enough for four thirty-two page books, long fingers picked them off the roll and laid them nicely on top of the cover; a central blade, made up of closely laid vertical rods, then decended on the middle of the book, forced the whole down through the slot and pressed the pasted parts together and folded the book, which then passed into a shallow box, where they were counted off in any quantity required.

In a word, clean paper from a continuous roll passed into one end of the machine and came out at the other as a printed pamphlet of thirty-two pages, pasted together and with a cover complete. The product showed *four* complete pamphlets connected end to end, which only required to be cut apart and trimmed on top and sides on another machine to be ready for distribution.

The press-work in the specimen we saw was excellent, though the pamphlet was full of illustrations: the register can be made absolutely exact, as it is simply a matter of preliminary adjustment, and all subsequent work is automatic. And, most wonderful of all, the completed pamphlets issue from this press at the rate of 5,000 copies per hour at normal speed; 50,000 in a run of ten hours, or over one and a half million printed pages in a day. Verily the hand-press and inking-pad of only a few decades ago is very much out of date. Instead of the edition of a few hundred copies, which was a laborious day's work for the old-time pressman, the machine we saw at work had just finished an edition of 7,000,000 almanacs, and was pouring out another order of 6,000,000 copies for another firm. So wonderful is the productive power of this machine, that an edition of 300,000 copies of any pamphlet is the minimum order upon which it will be set to work.

The company controlling this machine is a printing company, but does not sell the machine outright. One of them has been erected and is now working in Paris, and the Society of Civil Engineers of France recognized the talents of the inventor, Mr. Feister, by electing him an honorary member. Two more machines are being built for use in Philadelphia, and we understand others are being negotiated for other localities.

The Council of Engineering Societies on National Public Works.

The convention of civil engineers interested in the status of engineers engaged, or to be engaged on the national public works, met in Cleveland, O., on April 1, in accordance with the summons of the temporary committee.

The chief business transacted was the formal organization of a permanent body to be known as the Council of Engineering Societies on National Public Works. This new organization includes representatives from twenty-one societies, which have a membership of 2,605.

At the convention, with Mr. Louis J. Barbot presiding, Prof. J. Eisenmann, Secretary and Treasurer, presented the following report of the Committee on Organization, which was adopted:

To the Committee of the Council.

Your committee on permanent organization have the honor to submit the following report:

Whereas, The following societies embracing civil engineering in their organizations have adopted the recommendation of the Decemter conventions relating to the appointment of a permanent committee on national public works, to wit: Boston Society of Civil Engineers, Civil Engineers' Club of Cleveland, Civil Engineers' Society of St. Paul, Civil Engineers' Club of the University of Illinois, Connecticut Association of Civil Engineers and Surveyors, Denver Society of Civil Engineers, Engineers' Club of Philadelphia, Engineers' Club of Minnesota, Engineers' Society of Western Pennsylvania, Engineers' Club of St. Louis Southern Society, Illinois Association of Engineers, Indiana Association of County Surveyors and Civil Engineers, Iowa Society of Civil Engineers, Michigan Engineering Society, Nebraska Association of Engineers and Surveyors, Ohio Society of Engineers and Surveyors, Technical Society of the Pacific Coast, Technischer Verbund of New York and of Chicago, Western Society of Engineers,

Be it resolved, that we the accredited delegates of the committee of our respective societies, having perfected a permanent organization, adopt the following articles of organization:

1. That the organization be called the Council of Engineering Societies on National Public Works.
2. Its object is to promote an improved system of national public works.
3. The membership shall be composed of the members of the committees on national public works of the several engineering societies in the United States, provided that each committee shall be entitled to but one vote. Past delegates and all engineers interested in the promotion of the objects of this council may become associate members hereof with all the privileges of members except that of voting.
4. The officers of this council shall consist of a president, a vice president, a secretary, who shall also act as treasurer, and an executive board of seven members, including the president and vice president.
5. Meetings to be called by the president on the request of the executive board.
6. The officers shall be elected at any regular meeting by ballot, for the period of one year or until their successors are elected. The executive board shall have power to fill, temporarily, any vacancy that may occur.
7. Two thirds of the delegates reporting for any meeting shall constitute a quorum.
8. The order of business shall be provided by the executive board.
9. The articles of organization may be amended at any regular meeting by a three-fourths majority of the members voting.

While waiting for the Committee upon Nominations, Mr. Demster, chairman of the committte on the action of the convention, read the following report:—

Your committee on action fully recognizing the importance, magnitude, and difficulties of the work undertaken, present the following report: We recommend that the executive board collect from all sources within its reach such data as may afford the fullest information on the subject and formulate a plan for the creation, maintenance, and operation of a Bureau of national public works, as suggested in outline by the convention of December 5, 1885, send copies of the same to all the societies represented in the council and all others taking an interest therein, and after allowing ample time for the consideration of the same, submit it to the councils for consideration and discussion at a meeting called for the purpose.

The above report being adopted, Mr. Searles, of the Nominating Committee, submitted the following list of offices as nominated by his committee:—President, L. E. Cooley of Chicago; Vice President, J. B. Davis, of Ann Arbor, Michigan; Secretary, John Eisenmann of Cleveland, O.; Executive Board, L. E. Cooley, J. B. Davis, John Eisenmann, Augustus Kurth, of Brooklyn, N. Y., L. M. Haupt, of Philadelphia, Pa., R. E. McMath, of St. Louis, Mo., and L. J. Barbot, of Charleston, S. C. Upon the casting of a ballot the above mentioned nominees were declared elected.

The final business was a discussion of the ways and means for defraying the necessary expenses of the council; the committee on this subject recommended that the council make a careful estimate of the sum required for the coming year, and transmit a request to each society to raise, in any way deemed proper, their proportionate assessment. This recommendation was finally adopted, and the council adjourned to meet at the call of the executive board.

E. L. Corthell, C. E., Chief Engineer of the Tehuantepec Ship Railway, who was unable to be present at the Convention forwarded a letter strongly urging a certain line of action that was substantially adopted by the council.

In his letter Mr. Corthell expressed the belief that the best informed members of Congress, especially those familiar with river and harbor legislation, realize that the time has now come for an entire change in the administration of river and harbor works of the Government. The tendency seems to be to create a Board of Public Works, probably under the Treasury Department, which shall be permanent, and whose duty it shall be to thoroughly discuss and digest all information coming to it regarding public works, formulate systematic plans of work and make estimates on the basis of these plans to be submitted to Congress for its approval. Such a method as this would take out of Congress all preliminary discussion of river and harbor improvements, and prevent the adoption of ill-conceived and ill-considered schemes; and also prevent the disastrous process of scaling down estimates regardless of the merits of each case, and the trading of schemes among committeemen or in the House.

By a bureau so organized, the officials in charge of public works would be selected according to the judgment of the board or chief of bureaus; and this change in administration should lead to more efficient work and the appointment, from the higher to the lower grades, of men who are especially fitted by education, training and experience, to conduct engineering works of this character whether they technically belong to the army or the navy, or come from civil life. The board should and would have the power to obtain the best service wherever they might find it.

Mr. Corthell believes a plan as outlined above would meet the views of Congress, and strongly urged the organization formed at Cleveland to compile all facts bearing on the case and to be in readiness to present the case to Congress whenever this body is prepared to receive it.

Experiments With London Sewage.

The Metropolitan Board of Works are considering tenders for the construction of a vessel for carrying "sludge" to sea; they demand a capacity of 1,000 tons and a speed of ten knots per hour, with special arrangements for dumping its malodorous load. This vessel is to be an experiment.

As showing the quantity of sewage London has to deal with, the following figures are given in the *Daily News* of that city: The three intercepting sewers on the north side of the Thames discharge at Barking creek on the ebb tide from 80 to 150 millions of gallons daily; while the south side sewers, emptying at Crossness, pour out in the same time from 60 to 170 millions of gallons. At Barking all

the sewage is pumped up into a huge reservoir and stored until the ebb-tide, and until very recently the same was done at Crossness.

About the beginning of last year the Board of Works determined to see what could be done in the way of separating the solid portion of the sewage from the fluid, and decided to commence experiments with 1,000,000 gallons per day. After long trial they concluded that the best results in precipitation were to be derived from the mixture of a certain quantity of lime with the sewage, and then adding a solution of proto-sulphate of iron, afterwards running off the whole compound into subsiding reservoirs and allowing it to remain there at least two hours.

The practical result was that the whole of the suspended matter was precipitated, and the effluent water, after being treated with permanganate of soda, to rid it of possible chemical impurities, was discharged into the Thames. The sediment remaining in the bottom of the reservoir is swept up and pumped into "sludge settling tanks," there allowed to remain twelve hours, and the water accumulating on the surface in that time drawn off. The striking feature in this treatment of London sewage is, that after about 8 feet of tolerably clear water have been drawn off, there will remain only about half an inch of solid sewage. This is not absolutely all the solid matter that existed in the original sewage, but it is so nearly all that if the expense of perfecting the system was doubled, only another fiftieth part of solid suspended matter would be obtained. This proves the truth of the saying that it is not the sewage of London but the water that is added to it that constitutes the great difficulty.

The next problem in treatment is the disposal of the sludge. The Board by late experiments find that they can compress this matter by machinery; but even then 900 tons per day, the estimated sludge output, is a troublesome quantity to get rid of. A sludge-press weighing forty-five tons has just been put up which is to treat 9,000,000 gallons of sewage per day. In connection with this press are three receivers, strong iron receptacles, 6 by 12 feet, and sunk in the ground. One of these receivers is charged with air under a pressure of 100 pounds to the square inch. Into another is poured a certain quantity of lime dissolved in water, and then the liquid sludge is also injected with sufficient force to mix it well with the lime water. The third receiver is then put under water pressure, by which the condensed air in the intermediate receiver is driven into that containing the diluted sludge, which in its turn is forced from the receiver up into the press. The actual force applied is hydraulic, the air-chamber being simply a buffer between the water and the sewage to prevent their mixing. The ruling pressure is the 100 pounds per square inch, and this holds the sewage in the press, which latter is an arrangement of iron plates and jute cloths acting as strainers; through these strainers the whole of the moisture is practically expelled, and there is left a solid cake of about one-third of the volume of the liquid sludge and having the appearance when thrown in a heap of lightish brown clay.

The manurial value of this product is yet a mooted point, there being arguments for and against it. The problem now before the Board is whether it may not after all be cheaper to handle three times the volume as uncompressed sludge and carry it to sea, than to treat it in the press. To settle this question the sludge transport is to be built.

As an interesting feature in this treatment it may be mentioned, that year before last the permanganate of soda, under the cholera scare, ran up in price to £40 per ton. By increased facilities, and new factories the price fell to £20, and the demand having fallen off, manufacturers are now offering it at £11 per ton, and the Board has ceased to make its own.

Lighting with Gas, Fifty Years Ago.

The curious "remonstrance" given below has been lately dug out from some repository of "forgotten rubbish," and is worth reprinting as a word of warning to a certain class of doubting Thomases, yet in our midst, who take a seeming delight in acting the part of drags upon the wheels of progress. In the case here quoted the document was simply an outcome of mistaken judgment, and groundless fear of a, to them, most novel and startling innovation. It would be hard to say just what train of evils these same worthy gentlemen might not have foretold had they been unfortunately called upon to discuss the possibilities of electric lighting, steam heating, elevated railroads and the multitude of other common enterprises of the present day.

To the readers, outside of Philadelphia, we would say that the list of names appended to this document includes those of the then most prominent citizens, lawyers, judges, physicians and the leaders of Old Philadelphia generally, men who were supposed to reflect the intelligence and wisdom of that city.

We give the document itself, capitals and all, as follows:—

PHILADELPHIA, NOV. 28, 1833.

REMONSTRANCE AGAINST LIGHTING WITH GAS.

To the Honorable the Select and Common Councils of the City of Philadelphia:

GENTLEMEN:—The Subscribers beg leave respectfully to remonstrate against the plan now in agitation for LIGHTING THE CITY WITH GAS, as they consider it a most inexpedient, offensive and dangerous mode of lighting. In saying this they are fully sustained by the accounts of Explosions, Loss of Life, and great destruction of property, where this mode of lighting has been adopted.

We consider Gas to be an article as IGNITABLE AS GUNPOWDER, and nearly as fatal in its effects; as regards the immense destruction of property, we believe the vast number of fires in New York and other cities, may be in a great measure ascribed to this mode of lighting; the leakage of the pipes and carelessness of stopping off the Gas, furnish almost daily instances of its destructive effects. When we consider that this POWERFUL and DESTRUCTIVE AGENT, must necessarily be often left to the care of youth, domestics and careless people, we only wonder that the consequences have not been more APPALING. It is also an uncertain light, sometimes suddenly disappearing and leaving the streets and houses in total darkness.

The *Waters of the Delaware and Schuylkill*, now considered the most pure and salubrious in the world, as many long voyages have fully tested, must soon, we fear, experience the deterioration which has reduced the WATERS of the THAMES to the present impure and unhealthy State, for no reservoir will be able to contain the immense fetid drains from such an establishment, and very soon the river must be their receptacle to the destruction of the immense Shoals of *Shad, Herring* and other fish with which they abound; the same cause must produce like effects. *Salmon, Smelts* and other fish, formerly caught in vast quantities in the Thames have nearly all disappeared. The constant digging up of the streets, the circumstance of the gas pipes which at the intersection of each square must come in contact with the water pipes, are difficulties and evils which we would anxiously avoid,

In conclusion, we earnestly solicit that the lighting of our *city with oil may be continued.*

And your petitioners, etc., etc.

P. Syng Physick,	Chas. H. Dingee,
Horace Binney,	Jno. S. Warner,
Hartman Kuhn,	Geo. Pepper,
John Sergeant,	Richard Alsop,
Benjamin Chew,	Jacob Ridgway,
Chas. Wharton,	E. Styles Ely,
Paul Beck,	John Perot,
Henry Pratt,	Elihu Chauncey,
Jas. C. Fisher,	Roberts Vaux,
Joseph P. Norris,	John Markoe,
Thomas Allibone,	Geo. W. Smith,
Jno. C. Cresson,	Mat. Newkirk,
W. L. Hirst,	Wm. Platt,
Edw. A. Souder,	Wm. J. Duane,
H. Hollingsworth,	Hymen Gratz,
V. L. Bradford,	David Paul Brown.
Wash. J. Duffee,	And several hundred others.

PERSONAL.

EDWARD G. BROWN, a contractor, who built the Newark and Raritan Bay bridges and other important structures, died recently at Elizabeth, N. J., aged seventy years. Deceased was born in Maine.

JAMES D. HOLLISTER, Superintendent of the Florida Southern Railroad, has sent in his resignation to the company, to take effect on May 1st. SUPERINTENDENT HOLLISTER has held his position for several years.

PROF. J. A. L. WADDELL, late professor of civil engineering in the University of Tokio, Japan, will sail for America on April 13th. Until further notice, PROF. WADDELL'S address will be care of Horace Everett, Council Bluffs, Iowa.

The firm of HINDS, MOFFETT & CO. were dissolved by mutual consent on April 1st last, Mr. Frank A. Hinds retiring. The past business of engineering and contracting will be continued, however, under the firm name of MOFFETT, HODGKINS & CLARKE, and they will finish all contracts entered into by the old firm.

GENERAL JOHN NEWTON has been presented with the gold Laetare Medal of the University of Notre Dame. This is a medal presented yearly to some Catholic distinguished in letters, science or art, and in this case an engraved scene from the Hell Gate explosion adorns the center of the medal.

ALEX. BOWIE, an old employé of the Atchison, Topeka & Santa Fé Railroad Company, who has acted as Superintendent of the Canon City Coal Company, and later as Superintendent of the San Pedro Coal Company, and still later mining engineer and expert, has left the service of the company to accept a position in New Mexico, as Superintendent of Bell's Mines, at Gallup station, Atlantic & Pacific Railroad.

ALFRED MYDDLETON GAVEY has, with GEO. R. STUNTZ, a surveyor's office at the county building, Duluth, Minn. MR. GAVEY has recently become an American citizen. His experience has been as an explorer and surveyor of mining locations in the Dominion, an engineer of water-works in several towns of England and of railroads in Italy and the West Indies. At Port Arthur he conducted most of the surveys during the boom of '84 and '85. His schooling was under Mr. Frederick Bateman, Past-President of the Institution of Civil Engineers.

J. FERRIS QUINTARD, the proprietor of the Quintard Iron Works of this city, died on April 4th, at the residence of his brother, John A. Quintard, on Greene avenue, Brooklyn. He was born in Greenwich, Conn., in 1830, and was engaged in mercantile business in this city when the war broke out. He gave up his business and became Naval Paymaster on the United States steamer "Commodore McDonough," then under command of Capt. George B. Bacon. After the war Mr. Quintard became associated with John Roach, and later organized the iron works which bear his name. He leaves no family.

THEODORE T. S. LAIDLEY, Colonel of Ordnance, United States Army, died in Palatka, Fla., on April 4th, aged sixty-five years. He was born in Virginia, and was appointed from that State to the West Point Military Academy in 1838. He was graduated four years later and made an ordnance officer at Watervliet Arsenal, this State. He went to the Mexican war and participated in the siege of Vera Cruz. For gallant and meritorious conduct in the battle of Cerro Gordo he was made Brevet Captain on April 18, 1847, and the following October he obtained the title of Brevet Major for bravery in the defence of Puebla. After serving at the Washington, Charleston, and North Carolina Arsenals he was in 1856 made Captain of Ordnance for fourteen years' continuous service. He compiled a new edition of the "Ordnance Manual." For services during the rebellion he was made Major of Ordnance in 1863, and two years later, for faithful services in the Ordnance Department, he was made Brevet Colonel and was subsequently advanced to Lieutenant-Colonel. He served in command of the New York Arsenal from May, 1866, to April, 1871. In 1875 he was made Colonel. He was on the retired list at the time of his death.

GUSTAV LINDENTHAL, C. E., the well known bridge engineer of Pittsburg, Pa., has entered suit against S. L. Smedley, as Chief Engineer of Philadelphia, to recover compensation for professional services. The cases stated stands as follows:—In August 1883, Mr. Lindenthal came to Philadelphia to examine plans for the construction of the proposed Market street bridge, and while in the City Engineer's office, his attention was called to the difficulties attending the strengthening of the west abutment of the Chestnut street bridge. Mr. L. remarked that the proposed plan was very expensive, and a doubtful expedient and

offered to propose a plan and submit it. He did so by sending in a design for two cylindrical metallic struts to be sunk on the line of thrust of the main arch in the rear of the abutment and to be connected at the top by a metallic girder or girders imbedded in concrete, and distributing the load on the struts. Mr. Smedley acknowledged the receipt of this plan, but the matter rested until January, when Mr. L. was informed that his offer had been rejected. In March the plaintiff called at the office of the Chief Engineer, and found that a contract had been awarded for $53,000 to another party for a plan practically the same as his, saving that four cylinders were used instead of two and the cross-girder. Mr. Lindenthal claims that the plan was original with him, and that no such method had previously been contemplated. Mr. Smedley denies that the plan was original, or that it suggested the method carried out. The trial comes off in August, and the question to be decided is, whether the plan was original, and whether it was necessary to contract to retain a proprietary right to the design.

American Society of Civil Engineers.

At the regular meeting of the Society at its House on April 7, the announcement was made by Secretary Bogart that the last week in June had been fixed upon as the time of holding the next Annual Convention at Denver, Colorado. The citizens of Denver had offered to provide a place of meeting, and were arranging excursions that would exhibit to their visitors some of the difficult engineering and the grand mountain scenery of that neighborhood; the business of the Convention and sight-seeing were to occupy one week, but longer excursions would also be arranged for those members who had more time to spare. In answer to a query on that point it was stated that while a hall would be furnished for the meeting of the Society the "haul" to the place of meeting had not yet been definitely provided for.

Secretary Bogart then read a paper of Mr. Joseph M. Wilson in which he closed the discussion upon his paper on Specifications for Strength of Iron Bridges, read at the Deer Park Convention; this summation of the arguments advanced for and against his paper was very clearly treated, and was listened to with much interest by the members present, and some counter discussion followed.

The Amendment to the By-Laws voted upon was passed, and the following gentlemen were declared elected as members of the Society:

FOR MEMBERS.—Howard Nixon Elmer, (Rens. Pol. 1873.) Civil Engineer, St. Paul, Minn; John Butler Johnson, (Ann Harbor, Mich. 1878.) formerly U. S. Assistant Engineer, U. S. Lake Survey, Mississippi River Surveys and Examinations; now Professor of Civil Engineering, Washington University, St. Louis, Mo.; Charles Ward Raymond, (Cornell University 1878.) (Elected Junior, Nov. 7, 1877.) formerly Assistant Engineer, Department of Docks of New York City, Resident Engineer New York Works Hudson River Tunnel, Engineer Ball Electric Light Co., in Europe, recently Superintending Engineer Otter Creek Coal Shaft at Streator, Ill., now Civil Engineer, New York City; William Burroughs Ruggles, Chief Engineer and Master of Maintenance of Way, Ohio and Mississippi Railway, Cincinnati, Ohio; George Edward Thackray, (Rens. Pol. 1878.) (Elected Junior Sept. 6, 1882.) formerly Assistant Engineer in charge of Improving Missouri River at Leavenworth, Kansas; Constructing Engineer and Superintendent Youngstown (Ohio) Steel Co.; Superintendent Steel Works of the Buffalo Steel Foundry Co.; now Superintendent Spang Iron and Steel Co., Pittsburg, Pa.; Ignacio Ma de Varona, (Rens. Pol. 1863.) formerly Chief Engineer Nuevitas and Puerto Principe Railroad of Cuba; now Assistant Engineer in charge of the Aqueduct Extension of Brooklyn, Brooklyn, N. Y.

FOR ASSOCIATES.—Samuel Stockton Bogart, formerly General Traffic Manager Baltimore and Ohio Telegraph Co.; now Superintendent Telegraph and Signals New York, West Shore and Buffalo Railway, New York, Ontario and Western Railway, and Superintendent Baltimore and Ohio Telegraph Co., New York City; James Jackson Dana, President of the Hastings Pavement Co., New York City; Henry Ayling Phillips, formerly Resident Engineer Minneapolis, Sault Ste Marie and Atlantic Railroad, then with Boston Bridge Works; now Division Superintendent Fitchburg Railroad, Worcester, Mass.; Frederick Stafford Young, (Rens Pol. 1880.) Secretary Gilbert Car Manufacturing Co., Troy, N. Y.

FOR JUNIORS.—John Quincy Barlow, (Worcester Technical Inst. 1879.) recently Assistant Engineer, location of Cascade Division; now in Engineer's office, Northern Pacific Railroad, Tacoma, Washington Territory; John Joseph Donovan, (Worcester Technical Inst. 1882.) Assistant Engineer Yakima Division, Northern Pacific Railroad, North Yakima, Washington Territory; Stancliff B. Downes, (School of Mines, Columbia College 1882.) Assistant Engineer Department Public Parks, New York City; George Alfred Ricker, Assistant to Road Master, Buffalo and Rochester Divisions New York, Lake Erie and Western Railroad, Buffalo, N. Y.; William Tuttle Shepard, City Engineer's office, New Haven, Conn.; Walton Obadiah Titus, Assistant Engineer Mexican International Railway, Eagle Pass, Texas; Edward Ernest Russell Tratman, in charge of alterations of Merchant's Storage and Warehouse Company, New York City.

Engineers' Club of Philadelphia.

Record of Regular Meeting, March 20, 1886.

President Washington Jones in the chair: twenty five members present.

Mr. Charles G. Darrach explained the principles involved in the construction of Intermittent Syphons.

He said: The reason of the leakage from Intermittent syphons, as usually constructed, is due to two principal causes. The first is, that the vertical dimension of the orifice connecting the two legs of the syphon is made too great, and the head of water in the sealing trap at the end of long leg is overcome before the entire area of the orifice is filled with water.

Second. The partial vacuum produced in the syphon when the water drops out of it, (after the syphonic action is stopped), is not entirely destroyed, and the water rises in the short leg above that in the tank, and leaks out through the communicating orifice, at the upper bend of the syphon, whereas the air pressure in the syphon should be greater than the pressure on the water in the tank.

Mr. Darrach then described an intermittent syphon designed by Mr. Joseph M. Wilson, C. E., member of the club, in which these principles were recognized and which answered perfectly the object sought.

Modifications of this syphon, designed for grease traps, sewage or water flush tanks, and for syphon weirs to be used to draw from the lowest stratum of deep reservoirs without the aid of auxiliary syphons, were described, and the method shown by which the discharge could be made at stated intervals, or the water drawn down to any desired level within the range of atmospheric pressure.

In the syphons described, the short leg of the syphon is formed into an air chamber of sufficient size, to allow for the compression of air produced by the head of water in the sealing trap, and for the loss of air discharged from the long leg before the syphonic action is induced. A small hole (protected by a pipe, carried above the highest water level in the tank, when the syphon is used for grease or sewage) is made in the short leg or air vessel at such a height that it is exposed when the water level in the flush tank is raised by the back flow from the short leg into the tank. After syphonic action ceases, this hole and pipe continue to admit air to the syphon, and destroy the partial vacuum produced by the water dropping out of both legs of the syphon. By this arrangemement the syphon is always recharged with a full supply of air.

Mr. Darrach explained a number of experiments made by him to substantiate the theory.

Mr. Frederick H. Lewis read a paper on the Steel Rail Discussion, in which, after reviewing the recent comment on the wear of rails, he proceeded to answer the question, how steel can be chemically hard and and mechanically soft.

HOWARD MURPHY,
Secretary and Treasurer.

LITERATURE.

English and American Railroads Compared. By EDWARD BATES DORSEY. *M. Am. Soc. C. E. Transactions American Society of Civil Engineers.* July, 1886. 8 vo. pp. 78 with 4 plates and 41 tables.

Not only those who have formed their opinions of the comparative efficiency of American and English railroads from Colburn & Holley's European Railways, published in 1858, and failing to meet with any amendatory statement in print, still implicitly believe in the inferiority of American roads, but engineers and others who have paid some attention to the subject will be astonished at the conclusions Mr. Dorsey has drawn from the records of American roads, and a mass of information from hitherto inaccessible or scarcely known returns of English roads.

The study was undertaken, as we are told, "to show the American engineer the economy in operating railroads with good roadbeds, etc., such as the English have, over the generally inferior constructed roads in the United States," and the conclusion reached is that "the English railroads have cost per mile more than three times as much as the American, yet they only save eight per cent. of the annual operating expenses."

Of course no one would enunciate so startling a proposition as the above without having bestowed great care on the data and reasoning employed, and this was rendered particularly necessary by the fact that English roads return neither ton nor passenger mileage—only train mileage, nor do they separate passenger and freight expenses and earnings as in this country. The long, ingenious and laborious processes by which Mr. Dorsey makes the comparisons that apparently justify the assertion, last above quoted, are detailed at sufficient length to allow any one interested to judge of the value of his conclusions, if he accepts the data given, and as the authority, generally official, is in all cases mentioned the data seem unimpeachable.

There is, however, a certain amount of doubt consequent on the difference in accounts rendered or rather in the strict adhesion of the English roads to the train mile as a unit in their accounts, instead of the passenger or ton mile as with us. This difficulty Mr. Dorsey limits by assuming a uniform rate of 1 penny or 2 cents per ton mile, though he thinks 1¼d. or 2½ cents per ton mile near the figure, on this basis, from the tons moved and freight receipts, he arrives at the ton miles.

And in the same manner the passenger mileage is obtained by dividing the receipts from ordinary passengers by the total number transported, which gives the average receipts from each passenger, and this divided by 1½d. or 2$\frac{5}{16}$ cents, gives the average mileage. The passenger charge does not look unreasonable, but considering the interest the freight question now has in consequence of 'organized complaints from the "Association of the Chambers of Commerce of the United Kingdom," and other bodies, of high freight rates to which the present industrial and agricultural distress in England is said to be largely due, and the introduction by the Government of the Railway and Canal Traffic Bill into Parliament, noticed in our last issue, as well as the conclusions, Mr. Dorsey draws from this premise it is of interest to examine the reasonableness of the assumption.

In "The Annual Statistical Report of the Secretary to the members of the British Iron Trade Association," 1884, we find: "The average rates quoted for the transport of iron ores and coal in England could be varied either upwards or downwards, according to the distance or lead. But if the average rate is taken at 1d. per ton per mile, which is probably as near the mark as we can get, instead of the 1.03d. shown as the average for iron ore." This seems to show that Mr. Jeans, who has had exceptional advantages for comparing rates on the articles mentioned, considers 2 cents per ton mile fair for the mineral traffic, which amounts to 71 per cent. of the total freight traffic, the receipts on which are 42 per cent. of the freight receipt; though lacking the relative lengths of haul, no conclusion can be reached from these figures.

Sir B. Samuelson's report to the President of the Association of the Chambers of Commerce of the United Kingdom gives rates which probably were collected as high, if not maximum, rates some of these are reproduced in mills per ton mile, and for purposes of comparison the present rates between Chicago and New York are added:

TABLE NO. 1.

Distance in Miles	Rates in mills per ton mile. British.	American.
IRON WIRE.	Packed. Unpacked	
Birmingham to London 113	50.3 32.4	7.
" to Liverpool.. 97	46.9 30.0	7.
" to Hull..... 132	46.0 32.0	7.
" to Glasgow.... 286	29.0 22.5	7.
" to Manchester 84	49.0 30.0	7.
" to Coventry... 19	110.0 63.6	7.
HARDWARE.		
" to Liverpool.. 97	48.3	12.
" to London.... 113	50.5	12.
" to Glasgow.... 286	31.0	12.
" to Manchester 84	51.0	12.
" Plymouth.... 222	41.0	12.
SAWS AND TOOLS.		
Sheffield to Newcastle.. 53	59.4	12.
COTTON YARNS.		
Manchester to Hull..... 92	47.4	15.
" to Newcastle 142	39.2	15.
COTTON GOODS.	Export. Home.	
" to London.. 211	25.5 44.9	15.
" to Liverpool 31	53.2 82.0	15.
" to Hull..... 92	47.0	15.
" to Exeter... 226	..... 39.7	15.
" to Bristol... 177	..... 42.3	15.
MACHINERY.		
Leeds to Hull..... 51	59.2 118.5	7.
" to Newcastle..... 100	27.8 34.3	7.
Banbury to London..... 78	80.0 98.0	7.
Bedford to London..... 50	90.4 106 4	7.
" to Liverpool..... 152	65.8 86.0	7.
WOOLLEN AND STUFF GOODS.		
Bradford to Glasgow.... 210	47.2	15.
" to London..... 196	48.7	15.
" to Manchester. 40	87.0	15.
" to Birmingham 120	58.3	15.
EARTHENWARE AND CHINA.		
Stoke to Birmingham... 45	53.7 & 77.0	7.&15.
" to London..... 150	31.0 & 50.0	7.&15.
SUGAR.		
London to Sheffield 162	22.4	5.
Liverpool to Manchester 31	85.8	5.
COTTON.		
Liverpool to Manchester 31	36.0	5.4

Though the above rates are for short distances, the number of inhabitants in the cities mentioned makes the rates an important factor in judging of general rates, and the humble prayer of the fishermen, of Wick, against a rate of 65 shillings per ton, to London \$5.79 for 742 miles (which Mr. Mundella used to illustrate the unreasonableness of petitioners), on herrings and other kinds of cheap fish, where the rate per ton mile is 2 $\frac{1}{10}$ cents, against an American rate on salmon of 1 cent gives, though the fish were carried in special trains, confirmative evidence that Mr. Dorsey's assumption of a freight rate of 1d. per ton mile is too low rather than too high.

These high freight rates render possible an average income of 4½ per cent. on a capital of £800,000,000.

A late number of the *Colliery Guardian*, speaking of the result of the Hawkesbury bridge competition and our accorded superiority in locomotives, says, "the Americans are probably somewhat readier witted than Englishmen." As in locomotives, bridges, pumps, tools and yachting, or in fact in all departments of industry, which our circumstances call us to occupy we are easily ahead of the English, underselling them as well as furnishing a better article; the *Guardian* is probably correct, though our superiority in managing railroads seems so marked, according to Mr. Dorsey's tables, that some other cause should be looked for. One that will seem apparent to Americans is the absence of competition in England, where the rights of property invested, against that seeking investment, have a degree of soundness that the ordinary Yankee cannot comprehend. These rights, when assailed, are battled for in the courts and in Parliament. Mr. Dorsey gives the following as the expenditures upon that body for eleven years 1871 to 1882.

Municipal bodies.....	£1,289,757
Railway, Gas & Water Companies.....	4,664,874
Canal & Tramway "	416,013
Harbors & Docks "	560,574
	£6,731,248

Mr. Jeans in the report above referred to gives a table showing the expenditures of thirteen leading railways in fighting Parliamentary battles, 1872 to '82, which aggregates £2,289,000, or over \$1,000,000 per annum.

These efforts to prevent competition have in genera been so successful that the study and ingenuity here exerted to maintain a satisfactory relation between the gross and net incomes under rapidly falling rates, have not been necessary in England, and the ill effects of this absence from competition on English railway management are fully and carefully shown in Mr. Dorsey's paper and the numerous tables accompanying it though it should not be understood that he calls attention to the lack of competition.

Among the items developed by the investigation is the relative immunity from accidents on English and American roads as shown in the following table:

TABLE NO. 2.

Passengers killed and injured from causes beyond their own control on all the railroads of the United Kingdom, and those of the States of New York and Massachusetts in 1884.

	Total Length of line operated.	TOTAL MILEAGE. Train.	Passenger.	Ton.	Killed.	Injured.
United Kingdom	18 864	272.803.220	6.042.659.990	9.040,942 080	31	864
New York	7.298	85.918.677	1,729.633.620	9,322,518,571	10	124
Massachusetts	2,852	32,304,333	1,007,136,376	1,229,368,472	2	42

In 1,000,000,000 passengers transported 1 mile	United Kingdom	5.15 143
	New York	5.78 70
	Massachusetts	2 00 42
In 1,000,000,000 tons transported 1 mile	United Kingdom	3.44 96
	New York	1.11 14
	Massachusetts	1.63 34

		Miles.
The average number of miles a passenger can travel without being killed	United Kingdom	194,892.255
	New York	172,965,362
	Massachusetts	563,568,188
The average number of miles a passenger can travel without being injured	United Kingdom	6,992.662
	New York	13,940.754
	Massachusetts	23,955,630

If the comparison had been made for last year when no passenger was killed in New York, it would be still more favorable to American railroads.

Mr. Dorsey's table No. 16, giving the length of lines operated, capital train service, freight traffic, passenger traffic, earnings and rolling stock of the railroads of the United States and the United Kingdom, putting as it does the average English freight train load at 71 tons and the American at 125, is of interest in connection with the claims often made by the English that their locomotives are more economical of fuel than the American. Here it is seen that our freight trains are nearly twice as heavy as the English, in fact, if the freight charge, as assured by Mr. Dorsey at 1d. per ton mile, is as is probable ½ too small, and the net tons are reduced to gross tons, our freight trains have 2.4 times as much tonnage in them as the English, and considering our heavier grades and sharper curves it would be remarkable if we did not consume more fuel.

Mr. W. W. Evans long since showed conclusively that our engines performed a much greater mileage per annum than the English and lasted longer, but the author of the paper was "astonished to find that the motive power cost nearly twice as much on the English roads as on the American." The percentages on total operating expenses actually paid on repairs and renewals on locomotives being for fourteen English roads 7.8 and on ten American 6.1. Mr. Dorsey thinks on account of the much higher wages paid here the last percentage should be reduced to 4.6, but as these higher wages are paid for greater intelligence and efficiency it may be doubted if the reduction should be so great, and the figures as they stand, taking into account the inferior mileage of the English locomotives, must be sufficiently discouraging to our cousins over the water.

A prominent railroad man in England told Mr. Dorsey "that he had thoroughly tried the outside-cylinder engines, but had given them up on account of the great expense of repairs, that they wriggle themselves to pieces." Now, if on the roads selected for comparison by Mr. Dorsey, containing such crooked lines as the Boston & Albany, New York, New Haven & Hartford, Erie and Baltimore & Ohio, our locomotives run more miles and cost less for repairs, while on the English roads with flatter curves, easier grades and having presumably about as well surfaced roadbeds as ours, out-side cylinder engines "wriggle themselves to pieces," is it not probable that the fault is in the material and workmanship? Neither British materials nor workmanship are attacked by Englishmen to any great extent, though our contemporary, *The Engineer*, does occasionally lift its voice in warning, and sometimes a disaster like that of the "Oregon" sets men to thinking what the effect would have been if the iron used by permission of Lloyd's rules had been replaced by iron of strength equal to that used by Americans in like positions.

Mr. Dorsey's paper which will be widely read by investors and managers, contains, as noted above, much that is new and will doubtless add materially to our export of locomotives, which has already reached the value of \$3,000,000 in one year, and will doubtless increase the demand for services from our civil and mechanical engineers, and he should receive, as he doubtless will, their thanks.

The *Magazine of Art* for May will contain "Primrose Day," an article on Benjamin Disraeli, Earl of Beaconsfield, by George Saintsbury, with Portrait by Sir John E. Millaise, R. A., Edgar J. Boehm, R. A., Daniel Maclise, and Harry Furniss: and a page of caricatures from *Punch*, by Richard Doyle, John Leach, Charles Keene, Linley Sambourne, and John Tenniel, selected and redrawn by Harry Furniss; and "An American Collection," by Charles DeKay, with Engravings after Constable, Corot, Albert Ryder, A. Dagman-Bouveret, Eugène Delacroix and J. F. Millet.

CORRESPONDENCE.

Work at Flood Rock.

JERSEY CITY, N. J., April 3, 1886.

EDITORS ENGINEERING NEWS:

Your statement copied from the "Evening Telegram" in relation to "Work at Flood Rock," is so very inaccurate that I beg leave to correct it for the benefit of your readers There are three dredges engaged upon the work, one owned by the Atlantic Dredging Co. of Brooklyn, one by the Morris & Cummings Co. of New York, and the third by Ross & Sandford of Jersey City.—The largest owned by the Atlantic Co. removes about 900 tons per week, or an average of one scow of 150 yards per day. The second largest owned by Ross & Sandford is now averaging about 500 tons per week, and the other about 450 tons per week. The rock can be only blasted at slack water, as the current is too strong to allow of depositing the blast properly at any other time, so that but two charges of either 100 or 50 pounds each are put down in the twelve hours work. The largest machines use a grapple weighing 12½ tons each, and the smaller machine one weighing about seven tons. The rock at the lower end of the reef, the "Hen & Chickens," is not broken up at all from the original blast, to all appearances or by the results obtained. On the "Nigger Heads" it seems somewhat more shattered.

J. H. STAATS, C. E.
Engineer in Charge for Ross & Sanford.

THE HISTORY AND STATISTICS OF AMERICAN WATER WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

804. MENOMINEE, MICH.

Menominée, Menominee county, Michigan, in lat. 45° 5′ N., long. 87° 38′ W, is on low sandy ground at the mouth of the Menominee river, which empties into Green Bay, an arm of Lake Michigan. A considerable portion of the town is on made land, filled in with sawdust and slabs. Settled in 1822, it was incorporated a city in 1883.

Water works were built in 1884 by a private company, after plans of H. F. Dunham, taking the supply from the Bay through 1,000 feet of 12-inch and 250 feet of 8-inch pipe, leading to the pump well, whence the water is pumped directly into the mains by two compound Deane steam pumps. The ordinary pressure is forty pounds and the fire pressure seventy to 125 pounds. Distribution is by 9¼ miles of cast-iron pipe of 16 to 4 inches diameter, with 94 hydrants, 94 gates and 275 taps, and one meter. Service pipes are of galvanized iron.

The capital stock of the company is \$200,000. No further financial statements are furnished. The city pays \$75 each for seventy hydrants, \$70 for the next fifty and \$60 each for all after that. W. A. Lynch is President, B. J. Brown, Secretary, and F. E. Smith, Superintendent.

WATER

THE Water-Works Trustees, of Bluffton, Ind., awarded the contract for pumping machinery and hydrants to the Holly Manufacturing Company, of Lockport, N. Y.

JACKSON, TENN., will receive bids until June 1st for the erection of an electric light plant of sixty lights capacity.

THE Crawfordsville, Ind., electric light works have been purchased by the Crawfordsville gas light and coke company for the consideration of $15,000.

AT Seville, Fla., the water-works boiler and engine have been placed in position and work has been commenced on the tank. The sewer pipes have been laid.

THE contract for lighting the streets of Wooster, O., has been awarded to the Schuyler Electric Light Company of Hartford, Conn.

OBERLIN, O., will vote at the coming election on the question of issuing bonds to the amount of $500,000 for the purpose of constructing water-works.

THOMAS G. EATON, reported last week as having made a proposition to build gas works at Sanford, Fla., will erect the works and have them in operation by December 1st.

THE St. Louis Board of Public Improvements has ordered that bids be received on April the 13th for 5,600 tons of water pipes and 170 tons of special castings for the water department.

CHESTER B. DAVIS, C. E., of Chicago, Ill., has submitted to the Council of Lincoln, Nebraska, a plan for the sewerage of that city on the ordinary combined system.

RIPLEY & KIMBALL will furnish the pipe, hydrants, etc., for the new water-works in a Texas city. They have also sold the city of Dallas, Texas, a large amount of pipes, fittings, etc.

THE citizens of Whitestone, L. I., at a meeting held recently protested against the passage of the bill to bond the village for $50,000 for water purposes. They regard the bill as a scheme to benefit the rich men at the expense of the small property owners.

LAKE CHARLES, LA., March 27.—Oil was struck at the sulphur mine near here, on Thursday, in a stratum of hard limestone, at a distance of 400 feet, and 40 feet above the sulphur, as found heretofore. This is not in caving quicksand, but solid rock.

HAVERSTRAW, N. Y., April 3.—This city enjoyed a great celebration to-day, in the successful opening of its new water-works. The tests proved satisfactory. The system was designed by Mr. John Lockwood, of Brooklyn.

THE House has refused to concur with the Senate in admitting the petition of the town of Canton, Mass., for a repeal of the law of 1883, chapter 177, so far as relates to supplying Canton with water by the Sharon water company.

THE Holly Manufacturing Company, of Lockport, N. Y., are building two water power sets of pumping machinery—Gaskill type—for the city of Big Rapids, Mich. This pumping machinery will have a capacity of 3,000,000 gallons daily.

THE Holly Manufacturing Company, of Lockport, N. Y., have closed contract with the Denison Water Co., of Denison, Tex., for two Gaskill pumping engines with boilers. Engines to have a combined capacity of 3,000,000 gallons daily.

HARTFORD is not the only city having an unpleasant experience with cement lined sheet iron water pipe. The water board of Burlington, Vt., in their last annual report say: "We would earnestly recommend a liberal appropriation towards replacing the cement pipe in the lower parts of the city. Streets have been torn up, sewers demolished, and the cellars to several houses have been filled with water and mud during the year, by the bursting of these pipe, until no one can feel secure from similar annoyance, if they are so unfortunate as to live on a street in which there is a cement water pipe."

WATER COMPANIES.—The following have recently been incorporated:

The Michigan City Water-Works, Michigan City. Capital stock, $20,000. W. Knight and others, incorporators.

The Clifton Heights Water Company, Clifton Heights, Pa. Capital stock, $5,000. Treasurer, Wm. G. Fisher, Clifton Heights.

The Kankakee Water Company: Capital stock, $125,000. Henry C. Hodgmans, John L. Hotchkiss and Hamilton K. Wheeler, incorporators.

The Lyons Water-Works Company, Watertown, N. Y. Capital stock, $100,000. Frank A. Hinds and others, incorporators.

The Addison Water Company, Addison, N. Y. Capital stock, $50,000. Peter Herdic and others, incorporators.

No. 13. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

TOWN AND STATE.	Topography.	Difference of level in town.	In Business District.		Fire Pressure
			Day Pressure.	Night Pressure.	
		feet.	lbs.	lbs.	lbs.
Holyoke, Mass.	hilly.	150	55 to 90	60 to 100	55 to 100
Hornellsville, N. Y.	level.	0	100	103½	100 to 103½
Hudson, N. Y.	hilly.	173	60 to 130	——	——
Hyde Park, Ill.	level.	10	50	50	100
Ithaca, N. Y.	undulating.	100	60	60	60
Johnstown, N. Y.	hilly.	50 to 100	100	110	100 to 110
Joliette, Que.	level.	15	50	40	90 to 100
Keokuk, Ia.	very hilly.	115	60	50	120
Kingston, Ont.	sloping.	110	30	30 to 40	50 to 70
Kingston, N. Y.	hilly.	180	65 to 140	70 to 145	65 to 145
Knoxville, Tenn.	hilly.	110	——	47	——
Lansingburgh, N. Y.	level.	0	71	71	71
La Porte, Ind.	level.	0	30	20	80 to 100
Lawrence, Mass.	undulating.	120	70	70	——
adville, Col.	hilly.	46	70 to 75	70 to 75	75
Leavenworth, Kan.	rolling.	——	125	125	125
Lexington, Ky.	undulating.	50	40	35	90 to 100
Logansport, Ind.	hilly.	30	50	50	100
London, Ont.	level.	70	80	82	80 to 82
Long Is'd. City, N. Y.	hilly.	85	30	45	90
Louisville, Ky.	level.	0	30 to 40	48	30 to 48
Lynchburg, Va.	very hilly.	300	60	——	100
Lynn, Mass.	undulating.	125	60 to 65	70	60 to 70
Memphis, Tenn.	level.	0	30	40	30 to 40
San Francisco, Cal.	very hilly.	300	60	65 to 70	60 to 70

STAUNTON, VA., will purchase a new pumping engine for the water-works at a cost of about $7,000.

THE Scottdale (Pa.) Natural Gas Company has been incorporated. Among the directors are C. L. Graff and George Niles, of Pittsburg; H. C. Overhold, of West Newton; A. C. Overholt, James H. Campbell and J. M. Wood, of Scottdale. The capital stock is $5,000. The source of supply will be at East Huntingdon township, near the Fayette county line.

THE Water Board of Bay City, Mich., have made a contract with the Holly Manufacturing Company, of Lockport, N. Y., for a Gaskill, compound, condensing, pumping engine, having a capacity of 4,000,000 gallons daily. This pumping engine is guaranteed by the contractors to perform a test duty of 100,000,000 foot-pounds and is to be in operation by September 1st, next.

THE Lawrence Machine Co., of Lawrence, Mass., has secured the contract to place one of their high class Webber Centrifugal Pumping Engines at the Long Branch, N. J., sewage pumping station. The plant consists of a 12 H. P. tubular boiler, 6-in. class B pump coupled direct to a 5¼ by 5-in. engine, including all pipe and fittings.

THE Water-Works Company, of Tonawanda, N. Y. has contracted with the Holly Manufacturing Company for two Gaskill, compound, condensing, pumping engines of 2,000,000 gallons daily capacity each. These engines are guaranteed to perform a duty of 85,000,000 foot-pounds, and to carry a fire pressure of 125 pounds per square inch. Water is to be taken from Niagara river.

MESSRS. GOODHUE & BIRNIE, of Springfield, Mass., who have a contract for building water-works at Streator, Ill., have contracted with the Holly Manufacturing Company, of Lockport, N. Y., for two Gaskill pumping engines, having a combined capacity of 3,000,000 gallons daily, against a domestic pressure of fifty pounds, and a fire pressure of 125 pounds.

THE present debt of Boston is: City debt, gross, $42,924,332.04; county debt, gross, $850,000: total gross debt, $43,774,332.04. The sinking funds now amount to $18,482,753.41, and the net city debt is therefore at present $25,291,625.66. The net city debt in 1876 was $28,055,626.66, showing a decrease of $2,744,058.03.

WASHINGTON, March 29.—The rivers and harbors committee reported back the bill introduced by Mr. Gay for the digging of the Charenton (La.) canal, for want of jurisdiction. The bill has now gone to the committee on railways and canals, and Mr. Gay will appear before it an early day and present his views on the question. The sum asked for is $50,000.

THE Wakefield, Mass., Water Company has been authorized to issue $300,000 mortgage bonds.

MR. THOS. J. WHITMAN, C. E., conducted the duty trial for acceptance on the pumping engine at the Leavenworth Water-Works, which was furnished by the Holly Manufacturing Company, of Lockport, N. Y. It was a Gaskill pumping engine of 5,000,000 gallons daily capacity against a pressure of 325 feet, and he reports a duty of about 110,000,000 foot-pounds. The duty guaranteed by the contractors was 100,000,000. The engine has been accepted by the water company.

THE Inter-State Gas Company completed and put in operation the new gas works at Hutchinson, Kas., on the 15th ult. and will have disposed of their contract for lighting Eureka Springs, Ark., by the middle of April. Included in their undertaking at Eureka Springs, is the work of lighting the new $350,000 or $400,000 Crescent hotel, situated on a steep hill 400 feet above the gas works. The fixtures are already in for 600 or 700 lights for this house, and a garden at the top remains to be lighted yet. The company will soon begin the construction of water-works at Arkansas City, Kas., to have a daily capacity of 1,600,000 gallons. Two compound duplex pumps will be used. The iron pipes and mains have already been contracted for—with the Shickle, Harrison & Howard Iron Company. They will be 4, 6, 8 and 10 inches in diameter, and together with the castings, will weigh about 400 tons.

THE EARLY WATER SUPPLY OF PHILADELPHIA.—At a meeting of the Engineers' Club of Philadelphia, Mr. R. Hering read extracts from a "Report of the Committee on the Introduction of Wholesome Water into Philadelphia," dated in 1801. The report refers to the supply originally obtained from the Schuylkill river at Chestnut street, and distributed from the old tower in Center Square where the Public Buildings now stand. At the date of the report fourteen *cast-iron* pipes, each 6 feet long, were being tested to see if they would stand the pressure required and "to prove a method of securing the joints." Thirty-seven hydrants were in use, and sixty-three private houses were supplied with water. The engines cost $31,818.32, and could barely pump 3,000,000 gallons in twenty-four hours. The engineer who designed and superintended the erection of the works was paid $6,350 in full compensation for his services. Among the items of expense were $698.44 for "liquor" supplied to the workmen. The total cost of the water-works was $220,310.55½ as per the report.

BOSTON'S WATER SUPPLY.—The Boston committee on Water Supply has had under consideration the petition of the City Council for authority to increase the

water supply, by taking the water of the Shawsheen river. Mr. Dexter Brackett, assistant city engineer, in his evidence stated that the safe daily supply from the Mystic was 7,000,000 gallons for 100,000 persons, the average supply being seventy gallons per head. The whole supply was used last year, and the business in the valley is calculated to pollute the water. The Shawsheen supply is between 19,000,000 and 20,000,000 gallons daily with three basins. With the projected works completed, the supply exclusive of the Mystic would be 42,000,000 gallons daily, which would supply 600,000 persons. The 16,000,000 gallons of the Mystic river added to this would render the supply sufficient for the next twenty-five years. In the Shawsheen valley there are ninety persons to the square mile, and 900 to the square mile in the Mystic valley.

KANKAKEE, ILL., WATER-WORKS.—The Common Council have awarded the contract for the construction of the water-works system to Hinds, Moffett & Co., Watertown, N. Y. The contract provides for ten miles of mains, two pumping engines, each 1,000 000 gallons capacity per day, a tower 20 feet in diameter and 120 feet high to hold 300,000 gallons, 110 hydrants, and the works to stand a test of five one-inch streams 85 feet high through 410 feet of hose for a period of twenty-four hours; at an annual rental of $5,000 for a period of twenty years, the right of the city to purchase the works being reserved at all times. The rates to private consumers are to be as named in the ordinance. Messrs. S. D. Phillips & Co., put in a proposal as follows: to use steam power in compliance with the specifications; to take water from at or above Squaw creek; to use stand pipe or reservoir, 20 feet in diameter and 120 feet high; to put in and use Worthington pumps of the capacity of 3,000,000 gallons; to lay in addition to pipes in specifications a four-inch pipe to the I. I. & I. R. R. depot; for the annual hydrant rental (100 hydrants) of $4,250; and also to further agree not to issue bonds on said works to a greater amount than the actual cash value of the same. After some discussion the contract was awarded to Messrs. Hinds, Moffett & Co, at their bid of $5,000.

CLEVELAND'S PUBLIC WORKS.—City Civil Engineer Force, of Cleveland, O., has issued his annual report for 1885. The total amount expended for all classes of work is $560,779.86, an increase of $71,256.41 over the expenditures for 1884. Twenty-six streets were graded, aggregating 5 9-10 miles, at a total cost of $22,474.54. This is more than double the amount of similar work done during the previous year. Plans have been prepared for over twelve miles of sewers, and over seven miles have been constructed at a cost of $85,015.52. Although the mileage is 55 per cent. greater than in 1884, the total cost of construction is about 30 per cent. less, due to the fact that prices are much lower than during the previous years. One and a quarter miles of tributary sewers were also constructed, and this year nearly a mile and three quarters more will be built. With regard to the proposed tunnel under the city between the lake and the river, Mr. Force says: "My report last year contains an outlined plan for improving the sanitary condition of the river by intercepting and depositing into the lake the sewerage of Walworth and Kingsbury runs, and the sewers now discharging into the river, and also by creating an artificial current in the river from the lake during the dry season. Further study of this subject has not materially changed my views as then expressed. The appropriations recommended for the purpose of making the necessary tests and examinations of the nature of the material through which it will be necessary to construct the proposed tunnel, have been made by the Council and the examinations are now in progress. They are made by hand-boring inside of a five-inch wrought-iron pipe, driven by an ordinary wooden drop-hammer, operated by horse-power. The greatest depth driven is 200 feet, or 100 feet below the lake. The best material for tunneling thus far found is below the lake's surface. The report recommends that steps be taken towards rebuilding at least one of the draw bridges over the river each year. The dredging in the river for the year cost $17,914.17, against $34,401.59 for 1884.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Savannah, Dublin & Western Short Line R. R.—The road will be built at once between Savannah, Ga., and Macon. The branch from Dublin to Americus, which is being surveyed, will be built as soon as the main line is completed.

Stone Bridge for Kansas.—Marion county continues to build stone arch bridges, which are always satisfactory and never fall down, rot away or need repairing. Butler county should build stone bridges. It keeps the money at home, furnishes employment for home mechanics, and would be better in every way.—*El Dorado Republican.*

The Ravenswood, Spencer and Glenville R. R. Co. has been incorporated in West Virginia.

The Chicago & Northwestern R. R. Co. will shortly commence the construction of its Dekota extension to a point fifty miles north of Columbia.

Memphis & Charleston R. R.—The E. T., Va. & Ga R. R. Co. has again revived the project of building this railroad from Stevenson to Chattanooga and a corps of engineers will be put into the field to lay out a line.

Georgia Midland R. R.—The contract for the completion of the road to the E. T., Va. & Ga. R. R., via Griffin, has been signed and the work will shortly be let.

Central Iowa R. R.—The contract for building the road from Keithsburg to Lacon has been let to New York parties and work will commence at once. The road will be built to Streator, to connect with the C. & A. R. R., this summer.

Tow Path Railroad Suit Decided.—A decision has been rendered that the tow-path of the abandoned Wabash and Erie Canal between Worthington and Evansville, Ind., 100 miles, has reverted to the original owners, and the Evansville and Indianapolis R. R which uses the tow-path, as a road, will be compelled to purchase the right of way.

The Colorado Midland R. R.—LEADVILLE, COL., March 24th.—Mr. Thomas H. Wigglesworth, chief engineer of the Colorado Midland Railroad, arrived in this city yesterday and has established an office in the Bank of Leadville Building. He states that contracts for grading, tunneling and cross-ties will be let about April 1st, and he calculates that it will take twelve months to build the division between Leadville and Aspen.

Anamosa, LaPorte City and Eldora R. R.—This company has been organized in Iowa to build and operate a line from Anamosa, or some point in Jones county, to Eldora, or some point in Hardin county, by way of Laporte City. Directors, Dr. J. Wasson and William Wagoner, of Black Hawk county, and P. G. Henderson, John Stacey and E. H. Hatch, of Linn county. Capital stock, $2,000,000.

B. & O. R. R. Extensions.—The Philadelphia Board of Port Wardens has granted permission to the company to erect the draw span of the bridge across the Schuylkill river at Gray's Ferry, with the understanding that the span east of the draw channel be left open until the new span shall have been completed. The work is to be under the supervision of Master Warden Ross.

Montana Central R. R.—The whole line of the road from Helena to Red Mountains, has been let for construction and is now in progress and is going forward as fast as possible. A. W. McCune, of Butte, has contracted for the construction of thirty-one miles from Helene, and will begin work about April 1st. In addition, contracts for two tunnels on the Great Falls have been let, it is thought, to Muir Brothers, of St. Paul.

Dynamite for a Contractor's Boss.—RED WING, March 26th.—While the engineers employed on the Chicago, Burlington & Northern R. R., across the river, were returning from Diamond Bluff the other evening, they discovered upon reaching Morgan's Landing, a suspicious-looking box. Upon investigation, it proved to be filled with dynamite, with a cap attached, so arranged that with a sudden shock it would be exploded. As there has been, a few days previously, trouble between the men and one of the working bosses, it is supposed that it was placed there for his destruction.

San Antonio & Aransas Pass R. R.—Capt. M. Kennedy, the millionaire cattle-owner, has taken the contract to build and complete, by September 1st, the main line to Harbor Island, at Aransas Pass, and the branch to Corpus Christi. All the material for this portion of the line has been purchased and the engineer corps are at work. Capt. Kennedy also contracts to furnish the rails, fastenings and ties for the Waco branches, 210 miles; also for 100 miles northwest from San Antonio, on the road to the Panhandle. He takes his payment in bonds.

Union Pacific R. R.—The annual meeting was held in Boston, March 31st. The following Board of Directors was chosen:—Charles Francis Adams, Jr., Frederick L. Ames, Elisha Atkins, Ezra H. Baker, F. Gordon Dexter and John P. Spaulding, of Boston; Henry H. Cook, Sidney Dillon, David Daws, Andrew H. Green, Col. Gate Hoyt, of New York; S. R. Calloway, G. M. Dodge, of Omaha; James A. Rumrill, Springfield, Mass., and John Sharp, Salt Lake City, Utah. The company has determined to push its branch road, the Oregon Short Line, westward from Huntington into the Willamette valley. The workmen are now erecting the new iron bridges at Laramie river, Green river and Bitter creek, Wyo.

Toledo, Saginaw & Muskegon R. R.—Mr. Geo. L. Davis, chief engineer, has commenced running a line from Alma via Elm Hall, Crystal, Stanton and Sydney Center to Greenville.

Georgia Railroad Company.—The stock has advanced thirty-five points in two months. The road is leased to the Georgia Central R. R. Co., and there are rumors of a division of the surplus cleared by the Georgia Railroad Bank, and a declaration of a stock dividend at the annual meeting in May is whispered. The road is capitalized now at $4,000,000.

The Elmira, Cortland & Northern R. R. Co. will commence the work of constructing the road from Canastota to Camden, a distance of twenty-five miles, about April 15th. It is desired to get the new road in running order for the summer traffic. The abutments for the bridge over the canal must be laid before the opening of navigation. The Canastota Northern R. R. Co. has been organized to build the line.

The Danville & Northwestern R. R. Co. has been organized in Virginia. J. E. Schoolfield, President; B. S. Crews, F. X. Burton, W. T. Towns, E. H. Willer, T. B. Fitzgerald, of Danville, and W. W. Berry, of Bedford county, Directors. The route of the road will be from Danville through Pittsylvania and Bedford to Big Island, James river, where connection will be made with Alleghany, and eventually with the B. & O.

The Lehigh Valley Railroad Company is surveying a new route between Pittston and Fairview, to be used for coal and freight. It will follow close to the Lehigh & Susquehanna R. R. tracks, and between the two points the distance will be eight or ten miles shorter than the present road, which passes through Wilkes Barre and Sugar Notch. The road will also be a connecting a link for the Erie and Wyoming R. R. and Pennsylvania Coal Company.

St. Louis & San Francisco R. R.—There is much speculation as to the extension to Paris, Texas. The contract for tunneling Backbone mountain and for grading to Hackett City was let and the contractors came with men and teams and began putting up quarters for their men preparatory to commencing work on the tunnel. Hackett City property boomed up and several speculators bought land in the vicinity. The boom was checked recently, however, by the tunnel contractors being notified that the route had been changed and the tunnel would be constructed two miles from the place where they had prepared to go to work.

Fort Scott & Gulf R. R.—Arrangements for constructing the south end of the railroad from Fort Scott, Kan., to New Orleans are being made. The projected road will run from Arkansas to Bastrop, La., thence to New Orleans. It will be 1,200 miles in length, and will cross twenty-seven completed roads. The directors are: L. L. Bush, F. D. Smith, John Keller and N. A. Yeckes of Lancaster, Pa.; Chas. Pugh, Alex. McGaw, A. Cassell, E. C. Markley, M. Van Herlinger and S. L. Levy, of Philadelphia; C. F. Drake and John Perry, of Fort Scott; John Francis, of Topeka, Kan. The north end of the road from Fort Scott is now under construction. The estimated cost is between $10,000,000 and $12,000,000.

Michigan Central R. R. Co.—By a contract entered into between this company and the City of Ann Arbor, Mich., the railroad company agrees to make the following improvements: To commence the erection of a passenger depot at a cost of $20,000 immediately after the vacation of the streets. To build an iron bridge of a design to be agreed upon between the chief engineer of the company and Prof. J. B. Davis, at a cost of $13,000, over its tracks connecting Pontiac and Broadway streets, with stone and iron substructure, the roadway to be 30 feet in width, and to hold the city harmless from any claim of damages arising out of the work of construction of the bridge. To furnish the bridge with approaches on three streets, with connecting sidewalks and hand rails, the whole to be delivered to the city free of charge. To furnish access to the new station from State street for teams and foot passengers. To grant a convenient right of way for the city to open a street across its premises connecting State with Detroit streets.

CONTRACTING.

New Croton Aqueduct.—The strikers on Shafts 15, 16, 17, 18, 18½ and 19, (O'Brien and Clark, contractors) have returned to work and are being paid off and discharged. There is no difficulty in getting new hands.

Graving Docks.—The House Naval Committee has agreed to support a bill providing for the erection of three new dry docks at a cost of $600,000 each. The location of these docks will not be stipulated in the bill but will be left to the discretion of a commission; it is understood, however, that Brooklyn will be one of the places selected. The docks are not to be less than 480 feet long.

Colorado Capitol.—DENVER, April 1.—The contract for building the Colorado capitol building was let today to D. Richardson, of Chicago, for $930,485.

The Glasgow Underground Railway was opened March, 15. Two hundred trains will be run daily. The line starts from Queen-street and goes through Patrick to join the Dumbartonshire Railway.

Railroad Contract.—D. C. Sheppard & Co., have been awarded the contract to build the Manitoba's line from Elk River, via Princeton, to Milaca, on the Hinkley branch. The survey is practically completed and the line located.

Rome, Watertown & Ogdensburg R. R.—The contractors for the extension of this road from Potsdam Junction, N. Y., to Massena Springs are Ross & Sanford, of Newark, N. J., who have already begun work. The company organized to build the extension is known as the Norwood & Montreal R. R. Co.

Sewers.—The Philadelphia Council's Committee on surveys has awarded the contract for a storm water conduit at Falls Village, north of the P. & R. R. R. to Henry J. Becker for $46,906.50. Contracts were also awarded for building twenty branch sewers to nine contractors at prices ranging from $1.87 to $3.73 per linear foot.

The Boring and Blasting for the removal of Elderslie Rock from the Clyde as an obstruction to navigation have, after five years work, been practically completed by Messrs. Beaumont & Jones of London, at a cost of about £70,000: 16,000 holes, equal to 90,000 lineal feet, have been bored in the rock and 110,000 tons of whinstone and boulder clay dredged and in the work.

Curbing & Paving.—The Lowell, Mass., committee on streets has awarded the contract for furnishing curbing and paving during this year, to George N. Reed of Graniteville. His bid for paving is $44 per thousand, and for curbing 29 cents per lineal foot. Herbert R. Fletcher, West Chelmsford, has the contract for flagging at 38 cents per lineal foot.

Suburban Elevated R. R. Stations.—Mr. A. Namur has perfected plans for the stations of the Suburban Elevated R.R. above the Harlem river, which is to connect with the Second Avenue Elevated R. R., and the contract for building the same has been awarded to Messrs. Post & McCord. The style is similar to that of the depots on the Third Avenue Line, of a simple character, but built in a very substantial manner. Work is to be started immediately.

Wooden Viaduct.—The new wooden viaduct for which bids will soon be received at Omaha, Neb., is to be built over the Union Pacific and B. & M. tracks on Sixteenth street, and will be 1,500 feet long including approaches. There will be ten trapezoidal trusses, each 50 feet long, three 96 feet Howe trusses and one 150 feet Howe truss. The small trusses will be supported by pile and trestle abutments and the Howe trusses are to span the tracks, and will rest upon masonry piers. The total cost is expected to be in the neighborhood of $25,000.

Water Supplies.—The Richmond, Va., Council Committee on Water has awarded the contracts for supplies for the ensuing year. For all pipes and Y branches, to the Tredegar Iron Company; for special castings, 15,000 pounds, valves, fire hydrants and repairs to old pump works, to Tanner & Delaney Engine Co.; brass work, to G. & A. Bargamin; for lead and solder, to the Southern Railway Supply Co.; stop cocks, boxes (sizes 2 and 3), to W. J. Loth; for lumber for repairs at old pump works, H. B. Taliaferro & Co.; repairing, to J. A. Weinbrun; cutting trenches, to A. L. Phillips.

Sewers.—The following proposals were received March 31, at the Brooklyn Department of City Works, for the construction of sewers:

	15-inch cement pipe sewer.	12-inch cement pipe sewer	Manhole complete with head and cover.
	Per lin. ft.	Per lin. ft.	
John Bogert.....	$1.60	$1.30	$36.00
John Bray.....	1.40	1.10	35.00
Edward Gorman...	1.30	1.00	37.00
Daniel Gallagher..	1.25	1.15	38.00
James Rickard.....	1.13	0.93	33.00

Laying Water Mains.—The Minneapolis Board of Water Commissioners recently opened bids for laying about twenty-four miles of water mains during the coming summer. Bids for laying the tunnel in Fourth avenue were as follows: John Gleason & Co., 13 cents per lineal foot; John Gleason & Co., setting hydrants and boxes, $850; A. J. Dolan, 29 cents per lineal foot; Fred Youngren, 12 cents per lineal foot; John Burns, 19¾ cents per foot; A. J. Dolan, laying tunnel on Nicollet island, 27 cents per lineal foot; John Gleason & Co., 9 cents per lineal foot; Fred Youngren, 14 cents per foot; John Burns, 18¾ cents per lineal foot.

Concrete Sidewalk.—A resolution of the Providence, R. I. City Council ordering the improvement of a sidewalk has the following provisions: Three-eighths of of an inch rise per foot from the inside of the curb to the street line, except modification necessary to meet the occupation line. All material above grade to be excavated and removed. Good sand or gravel shall be used for filling whenever it may be required. The foundation shall be composed of clean, coarse gravel, properly coated with tar, and shall not be less than two inches in depth, after being rolled and thoroughly compacted. The top of the foundation shall be brought to a smooth surface by the addition of fine pebble, completely coated with tar and thoroughly rolled. The top dressing shall consist of clean, sharp sand, thoroughly saturated with tar, and applied in a layer of such thickness that, after being rolled and compacted, it will not be less than an inch in depth. The total depth of walk when finished shall not be less than three inches. The gravel and sand shall be thoroughly dry before coating or saturating the same with tar.

River and Harbor Bill.—Among the appropriations are the following:

Maine—Harbors: Rockland $20,000; Saco breakwater $12,500. Rivers: Lubec channel $10,000; Moosabec bar $10,000.

New Hampshire—Portsmouth $8,000.

Vermont—Burlington $15,000.

Massachusetts—Harbors: Boston $75,000, of which $25,000 is for part A of Fort Point channel; Lynn $6,000; Nantucket $15,000; Newburyport $50,000; Plymouth $6,000; Provincetown $3,000; Scituate $10,000; Wareham $10,000; Wood's Holl $14,500.

Illinois—Harbors: Chicago, $100,000; Calumet, $10,000. Rivers: Calumet, $25,000; Illinois, $100,000.

Indiana—Michigan City harbor, $45,000; Wabash river, $80,000.

Michigan—Harbors: Black lake, $5,000; Charlevoix, $10,000; Cheboygan, $15,000; Frankfort, $7,000; Grand Haven, $10,000; Grand Marais, $55,000; Ludington, $75,000; Manistee, $10,000; Marquette, $10,000; Ontonagon, $13,000; Muskegon, $12,500; Pentwater, $10,000; Portage lake, $15,000; Sandy Beach, $100,000; St. Joseph, $10,000; Saugatuck, $8,000; South Haven, $5,000; White River harbor, $10,000. Rivers: Clinton, $6,000; Detroit, $50,000; Hay lake channel, $100,000; Saginaw, $45 000.

Wisconsin—Harbors: Ahnapee, $15,000; Green Bay, $7,000; Kenosha, $5,000; Kewuanee, $10,000; Manitowoc, $15,000; Milwaukee bay and harbor, $80,000; Oconto, $8,000; Port Washington, $7,000; Racine, $10,000; Superior bay, $30,000; Sheyboygan, $15,000; Sturgeon bay, $2,000. Rivers: Chippewa, $25,000; Fox, $75,000; St. Croix, $7,500.

Unbalanced Bids in Cincinnati.—According to the *Commercial Gazette* of Cincinnati, the Board of Public Works and its engineer, Mr. Danenhower, are in trouble on the old score of unbalanced bids. In building the Hunt street sewer bids were called on an estimate of probable quantities which included 200 yards of rubble masonry and 100 yards of concrete. The contract was awarded for $46,000.50 to a person who bid $10 a yard on these items as against the next lowest bid of $46,904 with a price of $3 for the same work.

In the final estimate 2,002 cubic yards of rubble masonry were allowed and 1,861 yards of concrete; these extra quantities swelling the total price for the work to $91,346.62 or $23,466 more than if the contract had been let to the party bidding $3 for this class of work.

In another contract on the Walnut Hill sewer was an item of 550,000 feet, B. M., of sheeting, which was bid at from $20 to $40 per 1,000 feet B. M., and 940 yards of remodeling intersections. In estimating the aggregate amount of each bid it is charged that the timber was reduced to 50,000 feet and the item of remodeling raised to 5,000 yards; this classification gave the contract to a party who had bid $40 per M. for timber and 20 cents per yard on remodeling. The final estimate showed 1,048,780 feet, B. M., of sheeting and practically no remodeling of intersections done at all, and the total amount paid by the city was $150,487.82 whereas the successful original bid was only $92,919.

The Chief Engineer explains that it was the duty of the Board to award the contract to the lowest bidder and that in the Hunt street sewer the quantities were changed by reason of a change in plan over which he had no control; it was lowered to pass under instead of through the old Deer creek tunnel, on the advice of the City Solicitor, and the change in material and quantities was in his judgment necessary. The change in timber, it is stated, was due to a clerical error on the sheet of probable quantities on which bids were compared, an error not detected by the Chief; and the quantity was finally increased because the timber had to be left in the trench to protect water, gas pipes, etc. The quantities for remodeliug intersections were obtained by scaling from a map and a re-examination of the imperfect data on hand convinced the engineer that the original quantity was too small. The opening of the work proved that no such work was needed at all. It seemed that no attempt had been made by previous borings to ascertain what the material to be penetrated was like. The report of the investigation committee has not yet come to hand, but it seems there is little to be done in the matter now.

Kanawha River Dam.—Abstract of Proposals for the Iron Work for the Weir of Dam No. 6, Great Kanawha River Improvement, opened at 2 P. M. April 3, 1886.

			No. 11.	No. 10.	No. 9.	No. 8.	No. 7.	No. 6.	No. 5.	No. 4.	No. 3.	No. 2.	No. 1.
			E. J. Codd & Co.	H. A. Ramsay & Son.	The Tredegar Company, Richmond, Va.	Snead & Co. Iron Works, Louisville, Ky.	Manly & Cooper Manufacturing Company	Thomas Morris, Cincinnati, Ohio.	Pittsburg Bridge Company Pittsburg, Pa.	Queen City Bridge and Steam Forging Company, Cincinnati, Ohio.	Motherwell Iron & Steel Company, Logan, Ohio.	Mahlon & Jeremiah Miller, Cleveland, Ohio.	Ainslie, Cochran & Co., Louisville, Ky.
		Per lb.	6½ 5½	5¾ 3	7 3¼	11.15 4.85	6½ 3¾	5.7 5	9 3½	6¾ 3¾	5¼ 3¾	7.62 3.15	5 3¼
		Amount.	$4,485.00 2,972.50 302.00	$3,967.50 1,740.00 250.00	$4,830.00 1,895.00 210.00	$7,693.50 2,813.00 260.00	$4,485.00 2,030.00 228.00	$3,933.00 2,900.00 150.00	$6,210.00 2,050.00 500.00	$4,687.50 1,885.00 295.00	$3,795.00 1,895.00 268.75	$3,287.80 1,677.00 280.00	$3,490.00 2,247.50 240.00
			$7,759.50	$5,957.50	$6,935.00	$10,766.50	$6,743.00	$6,983.00	$8,760.00	$6,837.50	$5,948.75	$5,334.80	$5,977.50
	Approximate Quantities.	Lbs.											
	Wrought-iron for Weir	69,000											
	Cast-iron for Weir	58,000											
	The Traveling Winch complete												

Market Report of Engineering Materials.

New York April 8, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		1.95c @	2.10c
" steel		2.35 @	2.45
Tees		2.35 @	2.40
Beams and channels, American		3.0 @	
Tank Plates		2.15 @	2.20
Shell Plates		2.4 @	2.5
S sel plates, Tank		2.5	
WROUGHT-IRON PIPE. PITTSBURG.			
Butt welded, black	Discount	42½ @	45
" galvanized	"	32½ @	35
Lap welded black	"	60 @	62½
" galvanized	"	42½ @	45
Boiler tubes	"	55	
RAILS.			
Steel (large lots at mill)		$34.50 @	$35.00
Old rails		20.00 @	
Old rails, steel		22.00 @	23.00
R R. spikes		2.40c.	
R R. splice-plates		2.00	
R R. track bolts, square nuts		3.00	
Barb-wire fencing, galvanized			5.00
" painted			4.00
Corrugated iron			
Nails			
Iron, per keg		2.30 @	2.35
Steel do.		2.60 @	2.70

METALS.

COPPER.		
Lake Superior	$11.35 @	11.45
Other Brands	10.00	10.15
LEAD.		
Com. Domestic	4.90 @	4.95
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.50 @	5.70

BRICK.

Cargoes (afloat)			
Haverstraw	per M.	7. @	8.00
Fishkill			
Up-River		7.00 @	7.50
Jerseys		6 75 @	7.50
Long Island		8.00 @	8.50
Pale		4.00 @	4.25
FRONTS.			
Croton, red		12.00 @	15.00
" dark		12.00 @	15.00
" brown		11.00 @	14.00
Philadelphia pressed		24.00 @	25.00
Trenton "		24.00 @	25.00
Baltimore "		37.00 @	41.00
Buff "		33.00 @	35.00
Enameled English		65.00 @	130.00
" American		85.00 @	120.00
Fire brick		24.50 @	55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50 @	$3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60 @	2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55 @	3.00
BROOKS, SHOOBRIDGE & Co.	2.45 @	2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.65 @	2.90
K. B. & S. "	2.75 @	2.95
Stettiner, German	2.65 @	2.85
Lagerdorfer, "	2.45 @	2.75
Fieve. A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40 @	2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65 @	3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50 @	5.00
" Fine	8.00 @	10.00
" Portland	2.45 @	2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
K. B. & S.	2.35 @	2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00 @	1.10
Standard		1.15
Cabl 's Portland	2.15 @	2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand		

ASPHALT.

ROCK.		
Prices range per ton	$15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50 @	$3.50

LIME.

Rockland, common per bbl.	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95 @	1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95 @	1.00
" " No. 2 "	0.75 @	0.85
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "		
Brown stone, Portland, Ct. "	1.00 @	1.35
" Belleville, N. J. "	1.00 @	1.35
Granite, rough	0.45 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2¾ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @	20.00
Choice "	65.00 @	70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44 @	.50
Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
Plank, 1¼ in "	.28 @	.30
" 2 in. "	.38 @	.40
" 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2¾ × 4 to 4 × 6 in	.16 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00 @	40.00
YELLOW PINE, Girders "	25.00 @	30.00
Dressed flooring "	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in. "	5.75 @	6.00
" sawed 18 in. "	2.00 @	2.25
LATH, Cargo rate "		

PAINT.

Lead, white, American dry per lb	.04¾ @	.06
" " " in oil pure "	.06¾	
" English, B. B. in oil "	.08¾ @	.08¾
" Red, American "	.05¾ @	.05¾
Litharge "	.05 @	05½
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.10½ @	.12½
Paris green "	.15 @	.20
Umber, Amer. raw and powdered per lb.	.01¾ @	.01¾
Drop black, Amer. "	.07 @	.13
" " Eng. "	.11 @	.13
Chrome green "	.05 @	20
Oxide zinc, American "	.03¾ @	.04
" French "	.06 @	.08

Trade Notes.

THE St. Louis Sewer Pipe Company is crowded with orders and city contracts, and looks for a very large trade this spring.

PROJECTS are on hand to open up the granite beds in the neighborhood of Lexington, Ga.

THE New York Sleeping Car Company, which is erecting extensive works at East Buffalo, will give employment to between 1,600 and 2 000 men.

THE Stilwell & Bierce Manufacturing Co., Dayton, O, has recently made shipments of water-wheels to Russia, France and Australia.

THE Carnegies are rolling some immense steel plates for a San Francisco firm. Each plate weighs from two and a half to three tons, is 60 feet long, 30 inches wide and ¾ of an inch thick.

THE Pencoyd Iron Works are in full blast, the puddlers having returned to work at $3.75 per ton. The works will now be run night and day, though the firm states that business is not booming yet

President Howell has awarded the contract for building a new engine for the N. Y. & Brooklyn bridge to the Dixon Manufacturing Company of Scranton, Pa., at a cost of $4,050. Six new cars on the new combined side and end door plan will shortly be put in service.

THE Spang Steel and Iron Works, Pittsburg, have just rolled a large ingot weighing 4,600 pounds into a plate ¾ inch thick, which after being trimmed under the shears, weighed 3,400 pounds and measured 14½ feet by 9 feet. This plate was shipped, with a number of others, to California.

BIRMINGHAM ALA., March 28.—The Pratt Coal and Iron Company, Birmingham, Ala., has shipped a car load of coal to Mobile, where it was loaded on the Brazilian steamer, "Almirante Bawasa," and shipped to Brazil. This is the first shipment of Alabama coal ever made direct from the mines to that country.

ROBERTS BROTHERS, of Philadelphia, the purchasers of the Huntingdon Car Works, will not remove the buildings or machinery from Huntingdon, as was feared might be done. If a change should be made in the works, they will be devoted to the manufacturing of material and supplies for construction of iron bridges, especially for railroads

VINAL HAVEN, ME., March 28.—The Bodwell Granite Company has arranged, by arbitration with the Knights of Labor, a schedule which raises the wages of its 400 employes from 10 to 15 per cent. Scale cutters will receive $2.75 per diem; sharpeners, $2 60; teamsters, from $1.85 to $2.25; quarrymen, from $1.75 to $2; laborers, $1.65; boxers, $1 75, etc.

THE St. Louis architectural iron works have a $4 600 contract for iron work for the new building of the Brinkwirth and Nolker Brewing Company of that city. They will also supply what little iron work is needed for the new depot of the St. Louis Cable & Western Railroad Company, at the intersection of Cable and Narrow Gauge tracks, in the West End.

CEMENT.—Manufacturers of Rosendale continue to speak in confident terms over the prospect for the season and are calculating upon a full sale of their product. There seems to be some irregularity in tone, however, and no general rate fixed upon. Certain leading companies thus far are unwilling to talk business for less than $1.10 per bbl. here, and others, it is intimated, will accept $1.00, so that to a certain extent the market is nominal awaiting a good practical test. Foreign has arrived with considerable freedom, but was in part due on contract, and importers of the leading brands are obtaining former rates without much difficulty.

THE Italian Parliament has passed an Act somewhat akin to the French shipping bounty law. It provides for the grant of bounties of $5 76 a ton for iron and steel ships built and registered in Italy, $1.92 per indicated horse power on machinery and 58 cents per 100 pounds weight on boilers; $2 40 per ton on coal brought to Italy in Italian ships from ports lying outside the Straits of Gibraltar, provided that the cargo is not less than three-fifths of the ship's burden, and a bounty on navigation of 13 cents per net ton for every 1,000 miles run from Italy to non-European ports lying beyond the Suez canal and the Straits of Gibraltar

THE Atlantic Works, Boston, have lately erected large iron shears of the following dimensions: They are 130 feet long from the base to the center line of the head; the overhang clear of the capsill of the wharf, is 30 feet; and from the base is 45 feet, the shears being set back 15 feet from the end of the wharf. The spread of the legs at the bottom is 45 feet. These shears are constructed wholly of iron, the legs being built of 37 courses of plate iron with the circumferential seams double-riveted. The main back-guy is of steel wire rope 2¼ inches diameter, 285 feet long, and there are two side-back guys of 1¼ inches diameter, iron, 200 feet long. These shears are the highest in the country and are capable of lifting 150 tons.

THE Pennsylvania R. R. Co., will have three new ferry boats built for the Brooklyn annex route. They will be either of wood or iron, probably the former as Supt Jansen favors that material, as, being more elastic, they are better able to withstand shocks that may be received in entering slips, where iron boats might spring a bolt or slip a plate. They will be 150 feet long, 51 feet breadth of beam and 11 feet depth of hold The dimensions of the present boats are: length, 140 feet; breadth, 49 feet; depth of hold, 9 feet 6 inches. The new boats will be double deckers, and will accommodate about 800 passengers each. The engines will be built by the W. & A. Fletcher Company of New York. The average time for making the trip at present is sixteen minutes, with the new boats the time will be reduced to twelve minutes.

SHIPMENTS of Southern manufactured pig-iron continue to arrive at Philadelphia. These shipments are by no means unusual. They arrive by the Ocean Steamship Company's vessels, which ply weekly between that part and Savannah. A recent consignment included not only Alabama pig-iron but a large quantity of the ore shipped from the Chattanooga works, and carried from the works in Tennessee to Queen street wharf for $4.51 per ton, that sent from Alabama being carried at a much less rate of freight. A large iron water-pipe manufacturer has just closed a contract for a second lot of 10 000 tons of pig-iron to be delivered in Philadelphia. The principal users of the metal are R. D. Wood & Co., of Gloucester, N J; the Lobdell Car-Wheel Works, of Wilmington, Del., and several large stove manufacturers. The Ocean Line's steamers running to Boston and New York carry equally large cargoes.

WARNED NOT TO GO TO COLON.

WASHINGTON, March 26.—Secretary Bayard has received from Mr. Adamson, Consul-General at Panama, a dispatch in the nature of a warning to laborers in the United States to whom inducements are offered to go to Colon for employment on the Panama canal. Mr. Adamson states that in November last a contractor visited New Orleans and made arrangements for shipping men from that part to Colon. Several hundred have already arrived and they have begun to besiege the Consulate-General with their grievances. They were promised work which is not given them, at wages which they could not earn and live, because white men cannot stand pick and shovel work in the sun and rain of the Isthmus. The chances are the men would die before the bi-monthly pay day arrived. They were promised shelter which was not provided, and when they sicken the contractors and Canal Company will disclaim any responsibility. Mr. Adamson adds that there are far more laborers on the Isthmus than can find work, and that $5 a month and board and lodging furnished on a farm in the United States would be better pay than $1.50 a day on canal work on the Isthmus of Panama.

THERE is a very common but mistaken impression abroad that there are no degrees of skill in what is called ordinary labor. A single illustration will show the magnitude of this error. Take the simple operation of handling a rock drill, for instance. One man will drill holes true and parallel, while another, though quite as industrious and well-meaning, will do precisely the opposite. The result is that the former uses less powder for the blast, and the rock comes out in shapely masses fit to be made into dimension stone worth a good price, while the product of the latter is only serviceable for rubble work and not worth as much by many times its cost. Yet both the men rank as laborers, and this leads up to the consideration of another question about which many trades' unions make a fundamental mistake Under their regulations both the men I have supposed would have to be paid at the same rate of wages, and worse still, both have an equal right to employment, leaving the employer no discretion in the matter whatever, providing only that both were members of the union in good standing. In other words, they seek to fix the earning capacity of one workman as the standard of pay for all, and as it is certain that no man could long exist as an employer if his labor cost more than it produced, it is manifest that the employers as a whole are bound to adopt the lowest standard, and thus the better and more intelligent laborer is made to suffer in the interest of the poorer and more ignorant.—St. Louis "Globe Republican."